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REVIEW
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SERIES B.

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ACHARYA (C. N.) & KRISHNA RAO (K. S.). **Control of Fly-breeding in Compost Heaps.**—*Indian med. Gaz.* **80** no. 5 pp 272–273, 3 refs. Calcutta, 1945.

In the Bangalore system of composting now being used in many municipal centres in India, masses of refuse and excreta in trenches or heaps are covered with a layer of soil about two inches thick. This helps to prevent oviposition by flies but does not destroy eggs, larvae and pupae already present. Nearly all of these complete their development in the wet season, and many do so in the surface layers even in the dry season when the high temperatures of 60°C. [140°F.] or above developed in the mass destroy a large percentage. As municipal compost depots are near towns and infected material may be included in them, they are likely to endanger health if fly breeding is not prevented. It has been found possible to effect control by asphyxiating larvae, pupae and emerging adults by covering the mass from the fifth to the twelfth day with a piece of hessian treated to render it airtight. Both sides are smeared with two coats of a paste of equal volumes cattle dung, fine earth and water, the second applied after the first has dried. A layer of tar is then added, and, when this has dried, a dusting of fine earth. The hessian is one foot longer and wider than the trench or heap, and the edges are plastered down with a mixture of cattle dung and earth. In experiments with pits, trenches and heaps fitted with cages and artificially infested with larvae, the use of the treated hessian reduced emergence from 40–60 per cent. of the population introduced to 2–3 per cent.

RAINA (B. L.). **Larvicidal Fish of Kangra Valley**—*Schizothorax progastus.*—*Indian med. Gaz.* **80** no. 5 pp. 273–275, 1 fig., 10 refs. Calcutta, 1945.

A list is given of the introduced and more important indigenous fish that destroy mosquito larvae in India, and divergent views expressed in the literature on the usefulness of the native ones are very briefly reviewed. During a recent survey of the Kangra Valley, it was noticed that streams containing *Schizothorax progastus* were free of mosquito larvae, whereas larvae were present in other streams identical except for the absence of this fish. Its appearance and habits are described. It ate mosquito larvae in preference to other prey collected from its natural habitat, and starved or unstarved individuals consumed given numbers of larvae much more quickly than did corresponding examples of *Gambusia*. The young fish were more actively larvivorous than the adults. No mosquito larvae were found in the malaria seasons of 1943 and 1944 in

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12 reservoirs measuring 10 ft. by 10 ft. into which *Schizothorax* had been introduced. Streams were also successfully stocked. The fish were able to withstand a journey of 500 miles without ill effects, but have the disadvantage of being fairly large and good for food.

[Sheĭnker (K. P.).] **Шейнкер (К.П.). An Experiment in epidemiological chemical Prophylaxis at a Site of new Construction in Central Asia.** [*In Russian.*] —*Med. Parasitol.* **14** no. 4 pp. 56–62. Moscow, 1945.

Many Russian workers consider that the mass administration of drugs is of value in preventing the spread of malaria only in districts in which the population is stable and infection is not introduced by immigrating Anophelines. To test this view, mass treatment was carried out in 1943 in a settlement on the right bank of the upper Suir-Dar'ya, in north-eastern Uzbekistan, where a dam was being constructed. The population was constantly changing, and though Anopheline breeding places were few, there was some immigration of mosquitos from breeding places on the opposite side of the river. The commonest species and principal vector of malaria was *Anopheles superpictus*, Grassi, which was taken in small numbers in July and was abundant in the second half of August and September. *A. pulcherrimus*, Theo., was taken from the end of July, and single examples of *A. maculipennis* var. *sacharovi*, Favr, from the beginning of August. In spite of the high mean monthly temperatures in August and September (27·1 and 21°C. [80·78 and 69·8°F.], respectively), most of the mosquitos possessed a developed fat-body in the second half of August and all did so by mid-September. Housing conditions were such that contact with man was easy, and there were no cattle.

Plasmodium vivax was present in most of the blood films of primary cases examined in June–August, and *P. falciparum* in most of those examined in September and October. Only one infection with *P. malariae* was observed. The treatment consisted in the administration of 0·3 gm. acrichin (against the schizonts) and 0·04 gm. plasmocide (also against the gametocytes) daily for five days and then, after an interval of five days, of the same doses for two days repeated at intervals of five days to the end of the malaria season. It was begun in June and was at first confined to those who had had malaria in 1943 or were found to be gametocyte carriers, but was applied to others in August, when there was a marked rise in the incidence of the disease, and was extended in September to all newly-arrived workmen, the parasite index among whom was found to be 5·3 per cent. In this way, 4·5 per cent. of the population were treated in June, 5·6 per cent. in July, 14 per cent. in August and 15 per cent. in September. As a result, the number of fresh local infections was kept at a low level, 86 per cent. of the gametocyte carriers had only a few gametocytes in the peripheral blood, which reduced the probability of transmission, and reinfection occurred in only 1·45 per cent. of the men who had undergone regular treatment as compared with 15·2 per cent. of those who had not.

[Gogol' (V. A.).] **Гоголь (В. А.). Causes of the low Effectiveness of *Gambusia* in some Water Reservoirs in the Province of Samarkand.** [*In Russian.*]—*Med. Parasitol.* **14** no. 4 pp. 74–77, 9 refs. Moscow, 1945.

Observations in 1944 in ditches in Uzbekistan showed that the effectiveness of *Gambusia* in destroying Anopheline larvae was increased by freeing the water from surface vegetation, which hindered the movements of the fish and forced them to feed at lower levels, where their diet consisted chiefly of micro-organisms. They successfully controlled larvae over some 32 acres of swampland when the surface vegetation was raked away. Overgrown reservoirs in which the fish have not proved effective should therefore be cleared of all surface growth.

[Akhundov (I. A.) & Trofimov (G. K.).] **Ахундов (И.А.) и Трофимов (Г. К.). A Test of the Action of Green Oil and Naphthalene Residue on alate Mosquitos under industrial Conditions.** [*In Russian.*]—*Med. Parasitol.* **14** no. 4 pp. 77–78. Moscow, 1945.

In experiments in Azerbaijan, naphthalene residue and green oil [the source and specifications of which are not given] both proved effective against mosquitos when applied with a flit sprayer. The naphthalene residue was applied at rates of 0·27 and 0·33 oz. per 100 cu. ft. in a room and a shed, which were rendered air-tight, and all the numerous mosquitos found in them when they were opened half an hour later were dead or dying. Similar results were obtained in a shed in which green oil was applied at 0·25 oz. per 100 cu. ft. Naphthalene residue is preferred for living quarters as it is cleaner.

[Siganur & Bagira.] **Сиганур и Багира. Results of an Application of Thiodiphenylamine in Dusting from Aircraft in the Province of Kharkov.** [*In Russian.*]—*Med. Parasitol.* **14** no. 4 pp. 79–81. Moscow, 1945.

Three rivers in adjacent districts in the Province of Kharkov were dusted with phenothiazine (thiodiphenylamine) from an aeroplane for the control of Anopheline larvae in July and August 1944. The rate of application was 0·9 lb. per acre [*cf. R.A.E.*, B **33** 142]. Obstructions to the normal flight of the aircraft included trees, overhead cables and bridges. Counts of the larvae in samples of water before and after treatment showed that complete mortality was obtained in open stretches, but that the rate of application was in most cases too low to control all the larvae in those that were overgrown with vegetation. It is suggested that the rate should be increased by 20–50 per cent.

[Kirpichnikov (V. S.).] **Кирпичников (В. С.). On the Utilisation of *Percottus glehni* Dyb. (Fish, Family Eleotridae) for the Control of the Larvae of blood-sucking Mosquitos.** [*In Russian.*]—*Med. Parasitol.* **14** no. 4 pp. 82–84. Moscow, 1945.

Notes are given from the literature on the morphology and biology of *Percottus glehni*, a predacious fish that is common in fresh water in ponds, lakes and swamps in the Russian Far East and was observed in the laboratory to feed readily on larvae of *Anopheles* and other mosquitos. It frequents the vegetation along the banks of ponds or lakes, and examinations of stomach contents showed that it feeds mainly on insects, including larvae of Chironomids and mosquitos, and occasionally on young of its own species or other small fish. It reaches sexual maturity in two years and females then contain about 1,000 ripe eggs. It thrives in summer in waters that are devoid of other fish and can survive in winter even in ponds that are frozen almost to the bottom. A few hundred examples 1–3 years old kept a pool measuring about 1,600 sq. ft. completely free from mosquito larvae ; after it had dried up so that no fish survived, and been refilled by rain, it rapidly became reinfested. A survey showed that mosquito larvae were usually absent from water in which this fish was present, unless they were able to shelter from it among vegetation, though it was ineffective against species, such as *Aëdes togoi*, Theo., that breed very close to the banks, and its introduction into suitable malarious districts with a severe climate in which *Gambusia* cannot survive is suggested.

Leví Castillo (R.). **Experiencias sobre el control de los mosquitos mediante las algas Caráceas.** [Experiments on Control of Mosquitos by means of Characeae.]—*Bol. Inst. bot. Univ. Ecuador* 1945 no. 5 pp. 123–128, 17 refs. Quito, 1945.

The author describes experiments in Ecuador showing that the presence of the alga, *Chara fragilis*, has no effect on the development of the eggs, larvae and

pupae of five local species of mosquitos [*R.A.E.*, B **33** 2], and similar experiments with *C. nitella*, which gave identical results. The variety of *Anopheles pseudopunctipennis*, Theo., used throughout was *levicastilloi*, Leví Castillo.

ROBERTSON (J. D.). **Notes on the Gametocyte Threshold for Infection of *Anopheles gambiae* Giles, 1902, and *Anopheles melas* Theobald, 1903, in West Africa.**—*Ann. trop. Med. Parasit.* **39** no. 1 pp. 8–10, 4 refs. Liverpool, 1945.

Data given by Barber & Olinger in a paper already noticed [*R.A.E.*, B **20** 64], showed that they did not succeed in infecting *Anopheles gambiae*, Giles, in Southern Nigeria with *Plasmodium falciparum* from gametocyte carriers having less than 0·47 crescents per 100 leucocytes. An account is given of experiments carried out at Accra in the Gold Coast, with *A. gambiae* and *A. melas*, Theo., bred from fourth-instar larvae or pupae obtained from inland fresh-water breeding-places and the edges of a brackish coastal lagoon, respectively. Examination of about 10 per cent. of the larvae used confirmed previous findings that there was no mixing of the two species in either habitat. The females were allowed to feed 36 hours after emergence on apparently healthy gametocyte carriers, then kept in the dark in a small cage covered with a damp cloth and supplied with split raisins after two days. The stomachs were examined for oöcysts from the fourth day onwards. Out of 13, 12, 7, 8 and 13 females of *A. gambiae* fed on carriers having 0·07, 0·18, 0·27, 0·28 and 2·9 crescents per 100 leucocytes, 1, 8, 2, 4 and 12, respectively, became infected, and the total numbers of oöcysts in the mosquitos of the respective groups were 1, 24, 4, 7 and 259. A meal was found to average 2·03 mg. blood. On the basis of 7,000 leucocytes per cmm., it is calculated that the average number of crescents taken up by the individual mosquitos in the various groups would be 10, 25, 37, 39 and 400, respectively. On the assumption that half of the crescents were female, the theoretical maximum numbers of oöcyts in all females dissected in each group would be 65, 150, 130, 156 and 2,600. Possible reasons for the differences between the theoretical and actual numbers are given. Of 19 females of *A. melas* fed on a carrier with 0·15 crescents per 100 leucocytes, 12 became infected, with an average of 2·3 oöcysts per infected mosquito.

GILROY (A. B.) & CHWATT (L. J.). **Mosquito-control by Swamp Drainage in the coastal Belt of Nigeria.**—*Ann. trop. Med. Parasit.* **39** no. 1 pp. 19–40, 4 pls., 3 maps, 4 figs., 9 refs. Liverpool, 1945.

A detailed account is given of work undertaken in 1942 at the Royal Air Force Station at Apapa, near Lagos, to control malaria by swamp drainage designed to eliminate breeding places of *Anopheles melas*, Theo., which the authors consider a variety of *A. gambiae*, Giles [*cf. R.A.E.*, B **34** 138]. Most of the land was very muddy and intersected with deep, narrow creeks. Red mangrove (*Rhizophora racemosa*) was the only vegetation on the mud flats covered by the neap tides, but it was interspersed with white mangrove (*Avicennia nitida*) and areas of swamp grass (*Paspalum vaginatum*) on the slightly higher land flooded only by the spring tides [*cf.* **34** 5–6]. Anophelines bred throughout the *Avicennia* and were widespread in the swamp grass. As malaria rates had remained high in spite of the regular use of suppressive drugs, personal protection and spraying to kill adult Anophelines, oil and Paris green were tried for the control of the larvae. However, they could not penetrate the swamp grass, and drainage was adopted in 1942, the range of operation being one mile from the airport and camp. All villages within one mile of the camp were also removed between July 1942 and July 1943.

Data are given on tides and rainfall. The principle of the drainage is to build a bund on the low side of the area to be dried, with outlets that allow water

behind it to run out at low tide but prevent any return flow at high tide. Drainage ditches lead the water to the outlets. As the land was so level that the ditches could never run dry, they were dug so that enough water would remain in them to prevent the formation of isolated pools, give larvivorous fish access to all parts and reduce scouring to the minimum. Details are given of the construction of the bund, which is best placed some 50–60 ft. inland, the tide gates, which were concrete structures with the actual gates of wood, and the drainage channels. The gates should be opened for each falling tide (or once a day in the dry months). When a gate is opened, there is a rush of water from the basin behind it, but the outflowing current in the more distant reaches of the channel is not set up for some time and continues after the gate is shut, refilling the basin. This fluctuation of level may help to keep the basin and channel free of larvae. The effect of crabs on the works is discussed, and it is concluded that it is not serious.

Five swamp areas totalling 1,677 acres on the mainland and on islands were reclaimed. The cost of initial work and maintenance is discussed. The water table was usually lowered 18–24 ins. Drying out was extremely rapid, and mosquito breeding ceased within a few days of completion of the work in belts of *Avicennia* and *Paspalum* grass. Careful searching over a period of two years showed that drainage channels remain free from larvae, largely through the activity of small top-feeding fish. Should the typical fresh-water *A. gambiae* become established as the water in the channels becomes less brackish, it would be easy to flood them periodically on rising tides, and, by varying the salt-content of the water, make conditions unsuitable for both *A. melas* and *A. gambiae* and keep the fish healthy. A list is given of the species of fish taken from water varying from salt to brackish, with notes on their value as predators.

The daily Anopheline catch was not immediately affected by drainage of the mainland swamp, but fell off when drainage of a nearby island was complete. The daily average catch during most of 1944 was very much lower than in similar periods of 1943 and was continuing to fall at the end of the year. Persistence is attributed to scanty infiltration from outside the controlled area and overlooked breeding places in the drained swamps. A rainy-season peak may be due to breeding in temporary water. Monthly malaria rates at the Station are given for 1942, 1943 and 1944. The rate from April 1943 onwards, when there was a considerable fall attributed to the removal of the villages, is regarded as reasonably satisfactory.

Regular mosquito surveys of the reclaimed area were carried out between 1942 and 1944. Each comprised catches of adults at man-baited stations in the middle and on the borders of the controlled area, recording of breeding places and investigation of the infectivity rate of the chief vector of malaria. Adults were identified by sex and genus, and specific identifications were made periodically. Of the important local vectors, *A. gambiae* and *A. melas* were very abundant, together making up 96–99 per cent. of all Anopheline catches, and *A. funestus*, Giles, was rare. *A. pharoensis*, Theo., a vector of secondary importance, was abundant. The remaining species of *Anopheles* taken were *A. obscurus*, Grünb., *A. coustani*, Lav., and *A. coustani* var. *ziemanni*, Grünb., which were rare. The 24 species of other mosquitos included six natural or experimental vectors of yellow fever, of which *Culex thalassius*, Theo., *Mansonia* (*Taeniorhynchus*) *africana*, Theo., *Aëdes nigricephalus*, Theo., and *A. africanus*, Theo., were abundant or moderately so, and *A. aegypti*, L., and *A. irritans*, Theo., were rare. The only larvae found in the swampy foreshore, which is fringed with *Rhizophora racemosa*, were a few individuals of *Anopheles melas* in crab holes at its edge. The main breeding areas of this species were in the zone between the neap-tide and spring-tide limits, where Anopheline larvae were found in brackish water (9–35 gm. chlorides per 1,000 cc.), in swamps covered by marsh grass, shallow pools produced by the spring tides in the

Avicennia orchards and occasional man-made pools and pits. The larvae in pools with black saline mud had dark fronto-clypeal markings and dark chitinous structures, but some in equally salty water in pools with sandy bottoms were much lighter in colour and not more than 10 per cent. of the females bred from them had four-banded palps. The rest had three-banded palps but were probably *A. melas*. Temporary pools, usually grassy, wheel ruts and footprints, in which *A. gambiae*, *A. pharoensis*, *A. coustani* and *A. coustani* var. *ziemanni* breed, were of secondary importance. Anophelines were rarely found breeding on the sandy ground above the spring-tide level. Brief notes are given on the breeding places of mosquitos of other genera. Larvae of 27 species were found. Among them were *Eretmapodites chrysogaster*, Grah., and six species of *Aëdes* including *A. luteocephalus*, Newst., and *A. stokesi*, Evans, which are natural or experimental vectors of yellow fever. The percentage of females of *Anopheles gambiae* [presumably including *A. melas*] that contained sporozoites was 4·8 at the first investigation in 1942, 1·3 in February 1944, after removal of the villages, and 1·3 again in May. This shows the effect of removing the native child population.

An account is given of the afforestation of the recently-drained tidal swamps designed to increase drying-out, raise the surface by vegetable débris and provide an indication of the economic value of reclaimed swamps. *Melaleuca* was found particularly suitable.

BURTT (E.). **Hypertrophied Salivary Glands in** *Glossina*: **Evidence that** *G. pallidipes* **with this Abnormality is peculiarly suited to Trypanosome Infection.**—*Ann. trop. Med. Parasit.* **39** no. 1 pp. 11–13, 4 refs. Liverpool, 1945.

Among a large number of wild *Glossina* dissected near Amani, Tanganyika Territory, in 1937 [*R.A.E.*, B **31** 183] and additional wild flies used in experiments and subsequently dissected, all the individuals of *G. brevipalpis*, Newst., and *G. austeni*, Newst., had salivary glands of the normal size, but seven out of 376 of *G. pallidipes*, Aust., had the glands hypertrophied to about four times the normal width. The glands appeared chalky white by reflected light [*loc. cit.*], but under the low power of the microscope, they were brown, sack-like and coarse in texture. In subsequent years, seven similarly abnormal examples of *G. morsitans*, Westw., were found in two areas in Tanganyika 50 miles apart among 8,916 dissected. Two occurred in a single batch of 40 flies, and the five of which the sex was recorded were all females. The condition had previously been found by Whitnall in *G. pallidipes* of both sexes in Zululand [**22** 113], and F. L. Vanderplank and J. F. Corson observed hypertrophied glands in *G. pallidipes* from Shinyanga and very occasional examples of *G. morsitans* from Singida, respectively. In both Tanganyika and Zululand, the percentage of *G. pallidipes* with abnormal glands was about 2–3. Statistical analysis of data on trypanosome infections in the flies, which are given in a table, shows a highly significant correlation between hypertrophied glands and infection with trypanosomes of any type (*Trypanosoma brucei*, *T. congolense* or *T. vivax*) in *G. pallidipes*, a very highly significant correlation between hypertrophied glands and infection of the glands with *T. brucei* in *G. pallidipes* from Zululand, and no correlation between hypertrophied glands and infection of the glands with *T. rhodesiense* in *G. morsitans*.

VANDERPLANK (F. L.). **Infection of** *Glossina longipennis* **and** *G. fuscipleuris* **with** *Trypanosoma congolense*.—*Ann. trop. Med. Parasit.* **39** no. 1 p. 61, 1 ref. Liverpool, 1945. **A Note on wild** *Glossina austeni* **infective with** *Trypanosoma congolense*.—*T. c.* p. 62, 1 ref.

The first paper is a brief note on an experiment in which *Glossina longipennis*, Corti, and *G. fuscipleuris*, Aust., which are not known to transmit pathogenic

trypanosomes, were infected with *Trypanosoma congolense* in the laboratory by feeding them on infected sheep. In the second, the results are given of the dissection of 679 males and 123 females of the coastal race of *G. morsitans*, Westw. [*cf. R.A.E.*, B **34** 50, 51], 38 males and 28 females of *G. pallidipes*, Aust., 17 of each sex of *G. austeni*, Newst., and one of each sex of *G. brevipalpis*, Newst., taken in Morogoro, Tanganyika, in August 1944. *T. vivax* was found in 14 males and one female of *G. morsitans*, and *T. congolense* in 34 males and five females of *G. morsitans* and one female of *G. austeni* [*cf.* **32** 93]. *G. austeni* bit man in the field at midnight and at 2.30 a.m. and feeds readily on man in the laboratory.

Hill (M. A.) & Gordon (R. M.). **An Outbreak of Dermatitis amongst Troops in North Wales caused by Rodent Mites.**—*Ann. trop. Med. Parasit.* **39** no. 1 pp. 46–52, 21 refs. Liverpool, 1945.

Some 60 cases of dermatitis occurred in August 1944 amongst United States troops stationed in North Wales, following the refilling of mattresses with new straw. The rash was papular, and irritation was intense, particularly when the men were in bed. Two rodent mites, *Haemogamasus oudemansi*, Hirst, and *Hypoaspis fenilis*, Mégn., were found in the bedding and palliasses of the affected men, the latter in large numbers, and these and other rodent mites (*Eulaelaps stabularis*, Koch, *Poecilochirus spinipes*, Koch, and *Cheyletus eruditus*, Schr.) were found in samples of straw from the store of the affected unit and the main store several miles away. It is considered probable that the species found in the bedding were responsible for the dermatitis, but some of the other species in the stored straw may have been represented amongst the dead and unidentifiable mites collected in the bedding. Investigation excluded the possibility that other Arthropods, such as *Sarcoptes*, *Trombicula*, *Pediculoides ventricosus*, Newp., or insects were responsible. The outbreak of dermatitis ceased as soon as the palliasses were disinfested with steam, and had previously done so among men who had refilled their mattresses with straw from another locality. It is thought that the original straw became infested at the main store, where there was evidence of heavy infestation by rats, and that the mites were led to attack man by prolonged starvation when the straw was in store at the affected camp, which was free from rats. The literature concerning other outbreaks of dermatitis due to rodent mites, and the distribution and hosts in Great Britain of the species collected during the present outbreak are briefly reviewed.

Haget (A.). **Sur des dégâts causés par *Aleurobius farinae* de Geer et sur les dangers présentés par son abondance.**—*Rev. Zool. agric.* **43** no. 9–10 pp. 50–55, 20 refs. Talence, 1944.

The biology and importance of Tyroglyphids as pests of foodstuffs are briefly discussed, numerous references to external or internal infestation of man and domestic animals by them are cited, and a brief account is given of observations on a heavy infestation of foodstuffs in a kitchen in Bordeaux by *Tyroglyphus* (*Aleurobius*) *farinae*, Deg., in the course of which it was found that intense irritation of the skin in the two women living in the house was being caused by the mites.

Arias Marambio (J.). **Contribución al estudio de los metazoos parásitos del perro.** [A contribution to the Study of the parasitic Metazoa of Dogs.]—*Agric. téc.* **4** no. 1 pp. 59–71, 8 refs. Santiago, Chile, 1944.

The following is taken from the author's conclusions. The Arthropods found in the course of a study of the endoparasites and ectoparasites of 64 dogs

in Chile were *Heterodoxus longitarsus*, Piag., *Linognathus setosus*, Olf., *Pulex irritans*, L., *Ctenocephalides canis*, Curt., *Linguatula serrata*, Fröl., and *Sarcoptes canis*, Gerl., which occurred on 19, 4, 15, 61, 11 and 2 animals, respectively. No apparent lesions were associated in most cases with infestation of the nasal fossae by *L. serrata*. The greatest number of individuals of this species found in one dog was 18.

Ballou (C. H.). **Notas sobre insectos dañinos observados en Venezuela 1938–1943. . .** [Notes on harmful Insects observed in Venezuela 1938–1943. . .]—*Cuad. verde Com. organ. 3a. Conf. interamer. Agric.* no. 34, 151 pp., 6 pls. Caracas, 1945.

This work, which is noticed more fully elsewhere [*R.A.E.*, A **35** 18], is based on observations in Venezuela between March 1938 and December 1943. The first part includes lists of Arthropods injurious to man and domestic animals, showing the date and locality of the records. In the second part, the same records are arranged under the pests concerned.

Twinn (C. R.). **A Summary of Insect Conditions of Importance or Special Interest in Canada in 1944.**—*75th Rep. ent. Soc. Ont. 1944* pp. 45–49. Toronto, 1945.

Dermacentor andersoni, Stiles, infested a herd of 1,200 yearling cattle in the interior of British Columbia in spring 1944, causing paralysis in 400, of which 100 died. A severe local outbreak of *Simulium arcticum*, Mall., in central Saskatchewan in late May and early June resulted in the death of 94 cattle and 39 other farm animals and brief but serious illness in many more. This was reported to be the first such severe outbreak since 1918.

Cameron (A. E.). **Insect and other Pests of 1943.**—*Trans. Highl. agric. Soc. Scot.* (5) **56** pp. 37–61, 5 figs., 16 refs. Edinburgh, 1944.

Stomoxys calcitrans, L., has recently been troublesome on dairy farms in Scotland. It is found around farm-yards and byres from April to November, and is less common out-of-doors than in the byres, which it enters on the cows or independently. Brief notes, partly based on the literature, are given on its morphology and bionomics. There are three or four generations a year. The principal breeding places are heaps of old cow manure mixed with straw, and the best control measure is the proper disposal of manure. Records are given of several recent cases of infestation of cattle in Scotland by *Sarcoptes bubulus*, Oudm. (*scabiei* var. *bovis*, auct.), and the life-cycle of mites of this genus is briefly described. The recommended procedure for control is to clip the hair from the affected parts, soften the scabs with warm soapy water and apply lime-sulphur solution every four days all over the body until mites are no longer found. The solution can be made by suspending a bag containing a paste of 2¼ lb. sulphur, 1 lb. quicklime and a little water in a boiler in two gals. water, boiling for three hours with occasional stirring and making the solution up to two gals. with more water. Two pints of the liquid treat one animal.

Burtt (E. T.). **The Mode of Action of Sheep Dips.**—*Ann. appl. Biol.* **32** no. 3 pp. 247–260, 32 refs. London, 1945.

The following is largely based on the author's summary. An account is given of a study of the action on *Ixodes ricinus*, L., of some toxic substances used in sheep dips. Methods are described of confining ticks in small boxes on clipped areas on the back of a sheep and of suspending ticks for individual

tests by means of a bent pin dipped in rubber solution. Each toxic substance tested acted more rapidly at a given concentration in a medium in which it was less soluble, and chemical potential (concentration in the medium divided by concentration required to saturate it) is a better standard for comparison of the toxicity of different solutions than absolute concentration. Phenol is less soluble in P 31 oil (a refined kerosene of which the specification is given) than in water, and, at a concentration of 0·134 per cent., phenol in P 31 paralysed unfed larvae of *I. ricinus* 5–10 times as rapidly as phenol in water. Solutions of phenol in P 31 and in water that were in equilibrium and so had the same chemical potential were alike in their effect on the tick. Though phenols are toxic at low concentrations in water and very toxic as vapour, their greater solubility in wool-fat and rapid evaporation from their films make them ineffective as dips. Acid solutions of arsenious acid acted more rapidly than alkaline ones. Solid arsenious oxide as crystals or as a deposit on wool acted more slowly than sodium arsenite under the same conditions, owing probably to its slow rate of solution. Sodium arsenite and arsenious oxide readily penetrated the tips of the legs, and sodium arsenite the back of the tick also. Previous work on arsenical dips and the contact toxicity of wool dipped in sodium arsenite indicate that arsenic is a contact and not a stomach poison to ticks.

DDT [2, 2-bis (parachlorphenyl)-1, 1, 1-trichlorethane] penetrated the tips of the legs of the tick much more readily than the back or the other parts of the leg. It acted more rapidly at 1 per cent. in P 31 oil (solubility 1–3 per cent.) than in sesame oil (solubility 10 per cent.). Saturated solutions were alike in effect. Similarly, a 1 per cent. solution of DDT in vaseline (solubility less than 5 per cent.) was more effective than a solution in lanolin (solubility 15 per cent.), but there was little difference in the effectiveness of saturated solutions. DDT did not evaporate appreciably when a 10 per cent. solution in lanolin was exposed as a thin film on mica at 37°C. [98·6°F.].

Rotenone penetrated the tips of the legs of female ticks more rapidly than the back. Larvae were more rapidly intoxicated by 0·1 per cent. solutions in olive oil (solubility 0·2 per cent.) than in castor oil (solubility 1–2 per cent.). Saturated solutions did not differ in their effect. Robinson's finding that rotenone was more toxic to *Ornithodoros moubata*, Murr., in a mixture of xylenol, ground-nut oil and a petroleum oil than in one of xylenol and ground-nut oil only [*R.A.E.*, B **31** 67] is thought to be attributable to the lower solubility of the rotenone in the former. Both Robinson [**31** 5] and Wigglesworth [**31** 23] working with *O. moubata* and *Rhodnius prolixus*, Stål, respectively, found pyrethrum to be more rapidly toxic in mineral than in vegetable oils, and it is thought that this indicates that pyrethrum is less soluble in mineral oils.

The findings on the effect of solubility on toxicity are discussed. As the loss by diffusion of a small amount of a substance from a medium in which it is only slightly soluble greatly reduces the potential, the power of a solution to maintain a given initial potential is greater when solubility is high. In practice, media are needed in which the toxic substance is neither so soluble that a wasteful amount is needed to produce a high potential nor so insoluble that losses by diffusion cause the organism to be surrounded with a region virtually free of the toxic agent. The carrier activity of different oil bases for insecticides and the synergistic action of insecticides applied together may in part be due to changes in solubility and hence chemical potential.

Thirty-Ninth Annual Report of the Department of Agriculture (British Columbia) for the Year 1944.—176 pp., 1 pl., illus. Victoria, B.C. [1945.]

W. R. Gunn states in the Report of the Live Stock Branch (p. 84) that satisfactory results have been obtained in a campaign for the eradication of the sheep ked [*Melophagus ovinus*, L.] from flocks on Saltspring Island, British

Columbia, which has been in progress for two years. Of the 1,040 sheep in the area under control, 780 were dipped in a rotenone preparation in 1943 and about 500 in 1944. All dipped sheep were entirely freed of keds.

RUMREICH (A. S.) & WYNN (R. S.). **A Study of the Rodent-ectoparasite Population of Jacksonville, Fla.**—*Publ. Hlth Rep.* **60** no. 31 pp. 885 905, 2 figs., 40 refs. Washington, D.C., 1945.

This is the first of a proposed series of reports on the results of studies on the ectoparasites of rodents carried out some ten years ago in representative localities and intended to provide comparable data to serve as a basis for the systematic treatment of the epidemiologic aspects of plague and endemic typhus in the United States and Territories.

Rodents were collected in Jacksonville, Florida, on 243 days throughout 1934, in order to obtain representative samples of living animals from all parts of the surveyed area at all seasons of the year. Methods of collecting are described. Of the 5,245 trapped rats collected alive, which comprised *Mus* (*Rattus*) *norvegicus*, *M.* (*R.*) *rattus alexandrinus* and *M. r. rattus*, 4,668 (89 per cent.) harboured ectoparasites and 4,353 (83·4 per cent.) harboured fleas. Owing to accidental losses, the ectoparasites from only 4,158 rats of the two species (including both subspecies of *M. rattus*) and also from twelve young rats of undetermined species found in nests were available for final examination and identification. All the fleas and the lice and mites from 10 per cent. of the rats trapped (including uninfested ones) were studied. Of the fleas, 17,622 were *Xenopsylla cheopis*, Roths., 5,990 *Echidnophaga gallinacea*, Westw., 5,732 *Leptopsylla segnis*, Schönh., 593 *Nosopsyllus fasciatus*, Bosc, 405 *Ctenocephalides felis*, Bch., and 11 *Rhopalopsyllus gwyni*, Fox. Of the mites, 2,014 were *Laelaps hawaiiensis*, Ewing, 488 *Echinolaelaps echidninus*, Berl., 361 *Liponyssus bacoti*, Hirst, five *Atricholaelaps glasgowi*, Ewing, and one *Myobia ensifera*, Poppe. Of the Anoplura, 955 were *Polyplax spinulosa*, Burm., 537 *Hoplopleura hirsuta*, Ferris, and three *H. acanthopus*, Burm. In addition, one individual of *Leptopsylla segnis* was taken on *Sigmodon hispidus* and two of *X. cheopis*, one of *Echidnophaga gallinacea*, and one of *Leptopsylla segnis* on three mice (*Mus musculus*).

The data for fleas taken from trapped rats and for the mites and lice from the 10 per cent. sample were examined statistically. The manner in which adjustment was made for lost specimens is described, and the statistical constants used are defined. These are the mean (mean number of an ectoparasite per living host, including uninfested examples), the infestation rate (percentage of hosts infested) and the ectoparasite index, which was obtained by the same process as the mean except that abnormally high counts were reduced to a "normal" maximum, obtained by fitting the appropriate curve (that of the mathematical function that produces the best fit) to the frequency distribution of parasite counts. The monthly and annual means and infestation rates of all fleas and of the four chief species separately for the two species of rats are given in tables and discussed and also ectoparasite indices for all fleas and for *X. cheopis*. Similar data are given for mites and Anoplura.

Differences between the monthly values of each constant were marked, and the pattern of differences varied among the species of ectoparasites. The mean temperature, total precipitation and mean relative humidity in Jacksonville for each month of 1934 are shown, together with the corresponding average figures for several preceding decades. Values for *X. cheopis* and *Laelaps hawaiiensis* were higher and those for *N. fasciatus* and *Leptopsylla segnis* lower in the warmer half of the year than in the colder half, and the differences were highly significant, but there were no significant differences in values for *Echidnophaga gallinacea* or *P. spinulosa*. There was very little correlation between the constants and rainfall or humidity, except for a negative correlation

for *N. fasciatus* and humidity. The indices and infestation percentages of *X. cheopis* and *Laelaps hawaiiensis* in the commercial zone of the town were somewhat higher than in the residential zone and considerably higher than in the water-front zone, but only the latter difference was significant. No significant differences between zones were found in the case of *N. fasciatus*, *Leptopsylla segnis* or *P. spinulosa*. Values for *E. gallinacea* were not significantly different in the commercial and residential zones, but were significantly lower in the water-front zone. There were no significant differences for *X. cheopis*, *L. segnis*, *Laelaps hawaiiensis* or *P. spinulosa* taken indoors or outdoors, but outdoor samples showed higher values for *N. fasciatus* and *E. gallinacea*. The type of premises (food establishments, other business houses and residences) did not appear to have any significance. The high risk of typhus infection assigned to food establishments is attributable to the large number of rats in them and not to any larger number of fleas per rat or higher proportion of infested rats. The interrelationship of the constants is discussed, and it is concluded that, in the present state of knowledge, the use of both the mean and the infestation rate is preferable to the use of either alone, and that in asymmetrical frequency distributions containing atypical high ectoparasite counts, the mean should be adjusted toward the median by an appropriate precision mathematical procedure.

LESTER (H. M. O.). **Further Progress in the Control of Sleeping Sickness in Nigeria.**—*Trans. R. Soc. trop. Med. Hyg.* **38** no. 6 pp. 425–444, 9 refs. London, 1945.

There has been much general improvement in the sleeping-sickness position in Nigeria since 1939, in spite of the service [*cf. R.A.E.*, B **27** 97] being put on a maintenance basis to release staff for war work. A description is given of the characteristics of the three forms of the disease (mild, toxaemic and nervous) occurring in Nigeria and of its distribution there. It increased when the people moved out of towns in search of more fertile land, and movement of large numbers of labourers and increased transport facilities spread the infection. There is now a striking correlation in Northern Nigeria between areas of infection and lines of communication. The main belt is in the centre of the country, and the peripheral parts of the Northern Provinces are still practically free from infection, though heavily infested with *Glossina*. There is little sleeping sickness in the greater part of the south.

The control organisation, the extent of the work done and the therapeutic measures taken are described. High incidence of sleeping sickness depends on close contact between man and *Glossina*, and clearings designed to protect the population from attack as they pursue their normal occupation are the kind most generally used. Early work showed that, in much of Northern Nigeria, limited amounts of stream clearing would protect against *Glossina tachinoides*, Westw. The technique was partial clearings protected by barrier clearings a mile long [*cf.* **28** 199–200]. Such methods are not applicable against *G. morsitans* race *submorsitans*, Newst. K. R. S. Morris reported at a conference in 1943 that quite limited clearing near an inhabited area had greatly reduced the incidence of *G. palpalis*, R.-D., in the northern parts of the Gold Coast, and attributed this to its dependence on man as a source of food; and T. A. M. Nash has observed in Zaria province that *G. palpalis* died out in a patch of high forest with no game and few reptiles after a village in the centre had been moved away, though it was abundant before. This suggests that the absence or scarcity of game in thickly populated areas may greatly increase the effect of limited communal clearing. Much of Nigeria is thickly populated and game is scanty, so that both *G. tachinoides* and *G. palpalis* are largely dependent on man and domestic animals for their food. Wholesale destruction of the remaining game would make them still more dependent on man and would increase the risk of sleeping sickness. On the other hand, there are sporadic patches of

G. m. submorsitans in much of the less densely populated country and any general increase in game would undoubtedly lead to a corresponding increase in this fly. The policy adopted has therefore been to leave the game population unchanged.

A brief account is given of the Zaria sleeping sickness settlement scheme which was begun in 1937. Eradicative clearing was incorporated in this scheme which aimed at making a tsetse-free corridor, 60–70 miles long and about ten miles wide, extending from the main north-south railway line south-eastwards to the railway connecting Zaria with Jos. About 480 square miles of the corridor have been freed of fly. The population in the Zaria Emirate, which fell by 12 per cent. between 1923 and 1933 has since increased by about 24 per cent.

SHUTE (P. G.). **An Investigation into the Number of Sporozoites found in the Salivary Glands of *Anopheles* Mosquitoes.**—*Trans. R. Soc. trop. Med. Hyg.* **38** no. 6 pp. 493–498, 2 refs. London, 1945.

An account is given of three experiments undertaken to determine the maximum number of sporozoites in the salivary glands of Anophelines and the number of blood-meals necessary for all or nearly all of the sporozoites to be discharged. *Anopheles maculipennis* var. *atroparvus*, van Thiel, and *Plasmodium falciparum* were used, and the insectary was kept at 75–80°F. The results showed that very large numbers of sporozoites can be harboured in the glands (often 60,000 and more than 200,000 in two instances) and that even very heavily infected females have discharged most of the sporozoites after about 20 blood-meals. If the numbers of sporozoites discharged at each feeding were equal, a mosquito with 60,000 sporozoites would discharge 3,000 at each feed. However, in very heavily infected glands, enormous numbers of sporozoites are situated in the salivary duct, and most of these are probably discharged during the first few feeds. Therefore, a person bitten within a few days of the glands being invaded by sporozoites will receive a much heavier infection than one bitten after the mosquito has fed several times, irrespective of the number of sporozoites in the gland cells. These findings are compared with the figures suggested by Ross in his monograph *The Prevention of Malaria* published in 1910.

The technique used for estimating the number of sporozoites in the glands of the mosquitos, which can also be employed for estimating the number injected into a patient, is described.

LEVER (R. J. A. W.). **The Anopheline Mosquitoes of Melanesia.**—*Trans. R. Soc. trop. Med. Hyg.* **38** no. 6 pp. 499–501, 12 refs. London, 1945.

This paper supplements one already noticed [*R.A.E.*, B **31** 131] and consists mainly of a review of recent literature on *Anopheles punctulatus*, Dön., and *A. farauti*, Lav., which the author considers a variety of it [*cf.* **34** 122], with particular reference to data given in a publication by Taylor [**32** 95]. The author states that the distinction between the two forms has escaped wide attention among the Pacific workers and that re-examination of specimens in the British Museum has shown that both are present in material from New Guinea, New Britain, the Solomon Islands and the New Hebrides, *punctulatus* alone in that from the Admiralty Islands (Manus) and *farauti* alone in that from the Santa Cruz Islands, its eastern limit in the Solomon Islands archipelago.

WILSON (C. A.). **Lotus Borer ecologically antagonistic toward Mosquitoes.**—*Mosq. News* **5** no. 2 p. 50. New Brunswick, N.J., 1945.

On 5th August 1943, larvae of *Anopheles* (especially *A. quadrimaculatus*, Say) and *Culex* were abundant in a pond some 600 sq. ft. in area nearly covered with American lotus (*Nelumbo lutea*) in Fort Smith, Arkansas. Almost

all the lotus plants were dead, and examination showed this to be due to infestation by the Pyralid borer, *Pyrausta penitalis*, Grote, although the attack had been in progress only about a week. The pond was then oiled at intervals. A further inspection on 15th September showed that the growth of lotus had been completely destroyed, and ideal mosquito-breeding conditions had thus been eliminated. In view of the oiling, it was not possible to determine the degree of control effected by the destruction of the lotus plants, but it is suggested that the borer should be of interest to mosquito-control workers as it offers a natural method of reducing the breeding of mosquitos in a lotus-covered habitat.

Ferguson (F. F.), Upholt (W. M.) & Arnold (E. H.). **Tests with DDT as an Anopheline Larvicide.**—*Mosq. News* **5** no. 2 p. 51. New Brunswick, N.J., 1945.

DDT at 0·1 lb. per acre was found to be effective as an Anopheline larvicide when an emulsified solution was applied so as to form a surface film, emulsion or suspension [*cf. R.A.E.*, B **35** 15], but it was best as a surface film as lateral distribution was greatest. Bottom applications did not act so well as the other three types. The distribution of DDT and therefore its toxic effect were limited by the distribution of the solvent. DDT at concentrations up to 0·5 lb. per acre showed no marked lasting effect. In the laboratory, the bottom mud complex from natural ponds or swamps rendered DDT ineffective after 2–3 days. There were indications that living organisms were not responsible for making the DDT unavailable.

Barber (M. A.). **Field Tests of DDT in Solution in Crank Case Oil as a Larvicide against Anopheline Larvae.**—*Mosq. News* **5** no. 2 p. 54. New Brunswick, N.J., 1945.

Between June and October 1943, a 5 per cent. solution of DDT in waste lubricating oil was tested in western Tennessee and eastern Arkansas for the control of larvae of *Anopheles punctipennis*, Say, and *A. quadrimaculatus*, Say, in nearly 100 breeding places of many types. Waste lubricating oil is easily available and inexpensive, floats and spreads well, can be used in almost any weather, and at ordinary larvicidal doses did not harm operators, domestic animals, fish or rice. An oil can and oil gun were successfully used for dispersal, and scattering a mixture of 1 cc. solution in 10 cc. sawdust, dry sand or soil proved very effective. Cork dust is useful when it is necessary for the mixture to float very well. In still water, 2 cc. solution applied at one point was effective over an area of 2 × 17 yards and 10 cc. over 5 × 47 yards. In a stream, 150 cc. was effective for about 400 yards, and 360 cc. for about 1,100 yards in a larger stream. In general, 50 cc. per 1,200 sq. yards was effective in still waters, or much less in waters free from scum or other débris. Somewhat larger dosages are necessary for *Psorophora* than for Anophelines.

Simmons (S. W.) & others. **Tests of the Effectiveness of DDT in Anopheline Control.**—*Publ. Hlth Rep.* **60** no. 32 pp. 917–927, 3 graphs, 1 ref. Washington, D.C., 1945.

Tests on the use of DDT in sprays to leave a toxic residue for the control of adult Anophelines and as an Anopheline larvicide were carried out at Savannah, Georgia. In tests of sprays in houses, mosquitos were trapped while attempting to leave treated rooms by the windows. They consisted of populations that had entered through the door or through one-way traps, or released populations of *Anopheles quadrimaculatus*, Say. Adults of *A. quadrimaculatus* released in a treated room first rest on the walls and ceilings, which show no

direct repellency. They then begin to move from ceiling to lower walls, and the most affected individuals move to the light within 5–10 minutes. Knockdown usually begins in 8–18 minutes and is largely complete in 30–90 minutes. Mortality after 24 hours is nearly always greater than knockdown during the period of observation.

Four unoccupied rooms treated with 100–800 mg. DDT per sq. ft. were giving complete kill after 6–8 weeks, and one treated with 200 mg. gave complete kill after 22 weeks [*cf. R.A.E.*, B **34** 189], though the exposure necessary to give 50 per cent. knockdown was 55 per cent. longer than after eight weeks. The weighted mortality among mosquitos trapped in a vacant house with paper-covered plasterboard walls treated on 19th April with a solution of DDT in kerosene at 200 mg. DDT per sq. ft. averaged 75 per cent. during July and 66 per cent. during August. In a house with wooden walls, treated at the same rate on 22nd April with an emulsified solution of DDT in xylene [*cf.* **34** 98], the corresponding figures were 90 and 87 per cent. Many mosquitos died in the rooms without reaching the traps. The average weighted mortalities of trapped mosquitos from several unoccupied houses 20 weeks after treatment were 60–70 per cent. This may indicate that one treatment per season would suffice in the more northern malarial zones of the United States, while two might be desirable in the south. Mortality in occupied houses was lower than in unoccupied ones, chiefly on account of the untreated resting surfaces. Treatment of household effects is therefore recommended where possible. The weighted death rate of mosquitoes caught during August in occupied houses treated in June was only about 30 per cent., though actual rates were higher as mosquitos that died in the rooms were not recovered.

The most thoroughly tested formula consisted of 35 per cent. DDT and 4 per cent. Triton X-100 in xylene, which was added to six parts water to give a 5 per cent. DDT spray. This can be used in small-type sprayers without agitators. It did not damage rough absorptive walls at 4 cc. per sq. ft., but a 10 per cent. emulsion at 2 cc. per sq. ft. is preferable for less absorptive walls. The cost is discussed.

The toxicity of treated surfaces at intervals after treatment was determined by exposing mosquitos to them in a small cage about 3 ins. in diameter and ½ in. deep for a definite period, and examples are given of preliminary results obtained. *A. quadrimaculatus* showed a preference under such conditions for resting on a horizontal surface, and thus better exposure and higher mortalities were obtained on ceilings than on walls. Kills were good on old painted walls, but the DDT failed to crystallise on very recently painted surfaces. Observations made at night in a room, with a cow as host, showed that *A. quadrimaculatus* normally rests on walls long enough to obtain a lethal dose of DDT. Laboratory investigations were made in an exposure cabinet, formed of four treated wooden panels measuring 3×12 ins. fitted into a wooden frame, into which known numbers of *A. quadrimaculatus* were introduced by an air current. When a standard emulsion of DDT, xylene and water was used at 200 mg. DDT per sq. ft., complete mortality was obtained with exposures of 45, 60, 90 and 120 minutes one week, two weeks, one month and two months after treatment, respectively. Exposure time was prolonged to kill the small percentage of resistant adults. Mixtures of DDT and xylene in kerosene at 200 mg. DDT per sq. ft. gave about 80 per cent. kill after 18 weeks with exposure for 60 minutes, while DDT and xylene in pine oil gave 60 per cent. Kerosene-base sprays are about as effective as xylene emulsions, but the action of the DDT is somewhat delayed. PD544C, a light proprietary oil that will dissolve about 35 per cent. DDT, gave results in emulsion comparable with those given by xylene.

The form, penetration, and effectiveness of DDT deposits on the test chamber panels varied with the type of solvent. Within a limited range, the density of DDT made very little difference to effectiveness in the laboratory, for after ten

weeks and with exposure for 60 minutes, deposits of 50, 100, 200 and 300 mg. per sq. ft. gave mortalities of 70, 83, 82 and 74 per cent. respectively. The lowest dosage lost its toxicity sooner than the others, particularly in the field. Panels exposed to 14 inches of rain over a period of four weeks killed only 25 per cent. of mosquitos exposed for 30 minutes, while panels kept in the laboratory killed 75 per cent. and panels exposed daily to direct sunlight 65 per cent. [*cf.* **34** 129].

Preliminary work on DDT as a larvicide was directed towards substituting it for oil without radically changing the technique of application. The solutions used were emulsified in water before treatment, so that the total amount of spray applied was about the same (15–20 U.S. gals. per acre) as the quantity of oil generally used and the formulae were such that they formed surface films on, or emulsions or DDT suspensions in, the treated water. Surface films are obtained by a solvent lighter than water with the addition of an emulsifying-spreading agent, emulsions by a solvent plus an emulsifier, and suspensions by a solvent that is miscible with water added with a dispersing agent to the water for application. A typical formula for a surface film is 1·25 per cent. DDT and 0·5 per cent. B–1956 in No. 2 fuel oil, mixed with 15–20 parts water for application, and the stock for a typical emulsion is 35 per cent. DDT in xylene with Triton X-100 or a comparable emulsifier. Both gave excellent control at 0·1 lb. DDT per acre. Reducing the amount of solvent in the surface film slightly reduced effectiveness. There were indications that the emulsions were more harmful than the surface films to aquatic insects other than mosquitos. Gas condensate [**34** 80] was an excellent substitute for xylene as a solvent. Suspensions at rates similar to the emulsions (1 : 14,000,000 or 1 : 20,000,000) gave comparable results. Tests indicated that DDT at 0·1 lb. per acre should kill Anopheline larvae of all instars within 24 hours and that 90–95 per cent. of the kill effected by emulsions takes place within an hour of treatment. Samples from the surface of a pond treated with the emulsion at 1 part DDT per million gave complete mortality for 24 hours, and 30–40 per cent. kill after 48 hours, but no surface toxicity was apparent after four days. In laboratory tests, samples taken, without disturbing the film, from two inches below the surface of water treated with 5 per cent. DDT in fuel oil at 15 U.S. gals. per acre were not toxic to larvae up to 24 hours after treatment, but samples taken four days after treatment gave complete mortality in 24 hours. Application of 1·25 per cent. DDT in fuel oil at 0·1 lb. DDT per acre caused no subsurface mortality for five days but some 5–8 days after treatment.

Time-mortality curves for DDT in fuel oil at dosages greater than 0·02 part per million are typically sigmoid. Curves for dosages between 0·02 and 0·2 p.p.m. at 26–28°C. [78·8–82·4°F.] lie very close together with the critical regions between 1½ and 4 hours and the steepest points on the curve at 30–40 per cent. mortality. Time-morbidity curves are similar, though steeper, with the critical regions between 15 and 120 minutes. No mortality of pupae was noticed in field tests. In the laboratory, pupae of *A. quadrimaculatus* not more than 24 hours old at the beginning of the test showed no more mortality in water containing 1 p.p.m. DDT than in untreated water. A high mortality of pupae not more than 5 hours old was obtained with 4 p.p.m. DDT, but an equivalent amount of xylene solvent alone produced the same result. DDT in the concentrations and combinations applied seemed to have virtually no effect on most of the plankton organisms and a relatively large number of somewhat larger forms, and did no apparent damage to fish at 0·1 lb. per acre. Application at 1 p.p.m. killed various kinds of fish. Two laboratory tests are cited indicating that DDT is inactivated by the bottom mud complex. It is thought that something other than simple settling out is involved, as the bottom mud from treated ponds or containers was not toxic when agitated in the presence of mosquito larvae. The addition of clean sand or aquatic plants such as *Utricularia* to DDT did not reduce its toxicity appreciably.

EDDY (B.). **Division of Entomology and Plant Industry.**—*10th Rep. Dep. Agric. R.I. 1944* pp. 41–60, 4 figs., 1 map. [Providence, R.I.] 1945.

In sections of this report dealing with mosquitos in Rhode Island in 1944 (pp. 41, 47–48), it is stated that *Anopheles quadrimaculatus*, Say, breeds throughout the State and caused sporadic outbreaks of malaria before suppressive measures were taken. To prevent it from doing so again if infected persons returned from the forces, a campaign was carried out for reducing its numbers, by maintaining drainage ditches in good condition. It was present in a large majority of the freshwater breeding places examined in the course of a survey and was most abundant at the edge of the weeded sections. Larvae of 22 species of mosquitos were found and included *A. crucians*, Wied., and two species of other genera, which had not previously been recorded in the State. As most of the artificial breeding places of *Culex* other than catch basins were dried up, a sharp decline in the mosquito population was noticed in built-up areas when the basins were regularly sprayed.

NETTEL F. (R.). **Contribución al estudio de la distribución de los simúlidos en el Estado de Chiapas.**—*Medicina* **25** no. 495 pp. 455–459, 1 map, 6 refs. Mexico, D.F., 1945. (With a Summary in English.)

Over 13,500 Simuliids of nine species were collected between January 1943 and February 1944 in 256 localities in the south of the State of Chiapas, southern Mexico. Catches were made on man in the mountainous regions where onchocercosis [caused by *Onchocerca volvulus*] is prevalent and on domestic animals near the coast where locally acquired cases of the disease do not occur. The most abundant species, with the number of each taken, were *Simulium metallicum*, Bellardi (6,267), *S. ochraceum*, Wlk. (5,005), *S. callidum*, Dyar & Shannon (1,751), and *S. haematopotum*, Malloch (296), each of the others being represented by less than 85 individuals. In three of the four mountain zones (out of ten studied) in which onchocercosis was most abundant, *S. ochraceum* was the most prevalent species followed by *S. metallicum* [*cf. R.A.E.*, B **34** 169]. *S. ochraceum* was also the most plentiful species in the zone bordering on Guatemala, in which the incidence of onchocercosis is low. Catches were highest in November, December and January, at the end of the rains. *S. callidum*, *S. metallicum* and *S. haematopotum* bit both man and domestic animals, but *S. ochraceum* was taken on man only. One species and one variety not included in the main list were recorded in independent studies.

COSTA (O. G.). **An extensive Case of Chigoe Infestation (Dermatophyliasis).**—*J. trop. Med. Hyg.* Oct.–Nov. 1945 pp. 121–122, 1 fig. London, 1945.

An account is given of a case of infestation by *Tunga* (*Sarcopsylla*) *penetrans*, L., in a farm worker in Belo Horizonte, Brazil, that was remarkable in that the hands, elbow, gluteal region and knees were involved in addition to the usual sites. Intense irritation of the toes had begun about two months earlier, after the man had taken up stable work. The habits of *T. penetrans* are briefly described.

PAPERS NOTICED BY TITLE ONLY.

WRAY (F. C.). **A Guinea Pig Holder** [for feeding mosquitos].—*Mosq. News* **5** no. 2 pp. 52–53, 3 figs. New Brunswick, N.J., 1945.

STAGE (H. H.). **References to Literature of Interest to Mosquito Control Workers** [chiefly published in 1944 and 1945].—*Mosq. News* **5** no. 2 pp. 72–76. New Brunswick, N.J., 1945. [*Cf. R.A.E.*, B **34** 188.]

Mellanby (K.). **Scabies in Bengal.**—*Indian med. Gaz.* **80** no. 6 p. 296, 1 ref. Calcutta, 1945.

Many reports have recently appeared alleging that scabies is epidemic and affects a great proportion of the population in Bengal [*cf. R.A.E.*, B **33** 179] and other parts of India. As there was some doubt as to whether the condition was in fact due to *Sarcoptes*, the author examined persons with skin infections at a hospital, an out-patients' clinic and a camp for destitute persons in Calcutta. He concluded that most were suffering from infestation with *S. scabiei*, Deg., and that the condition was widespread. Most of the destitute people showed evidence of recent infestation. Live mites were present in very small numbers. Most patients had been infested for years and had developed a substantial immunity from *Sarcoptes*, resulting in the small mite populations, but re-infestation occurred frequently, owing to the prevalence of the condition, overcrowding and the warm moist climate, and these individuals, being hyper-sensitive, gave a maximum reaction. No individual was found to have developed a tolerance to *Sarcoptes*. The widespread skin lesions were almost entirely secondary and possibly intensified by malnutrition. Some dermatitis was due to over-treatment with sulphur.

Treatment with tetmosol soap [soap impregnated with tetraethylthiuram monosulphide (*cf. R.A.E.*, B **33** 59, 89, 160)] is not practicable in India, as poverty prevents most people from using any kind of soap. The general practice is to cover the whole body daily with oil, and it is suggested that a small percentage of tetmosol or 1 or 2 per cent. mitigal [dimethylthianthrene (*cf.* **32** 146, etc.)] might be incorporated into the oil.

Sen (S. K.) & Minett (F. C.). **Experiments on the Transmission of Anthrax through Flies.**—*Indian J. vet. Sci.* **14** pt. 3 pp. 149–158, 1 pl., 19 refs. Delhi, 1945.

The literature on the transmission of anthrax by flies is reviewed, and a detailed account is given of experiments carried out in Mukteswar between May and October from 1941 to 1943 on the transmission of the disease to goats by *Stomoxys calcitrans*, L. [*cf. R.A.E.*, B **2** 73, 169 ; **3** 197], *Musca domestica*, L., *Calliphora erythrocephala*, Mg. [*cf.* **8** 105] and, in a single test, *Sarcophaga* sp. Experiments with Tabanids were abandoned because they would not feed in captivity. The daily maximum temperature range was 64–80°F. Goats are more susceptible to experimental inoculation than cattle.

Stomoxys calcitrans failed to transmit anthrax by biting normal skin 0–42 hours after feeding on an animal with the organisms in the circulating blood, by biting scarified or cauterised skin 0–30 minutes after feeding on carcase wounds, or by defaecating on scarified or cauterised skin 0–4 days after feeding on an infected animal. Anthrax was set up by applying a culture suspension lightly to the freshly cauterised skin but not by applying it to skin from which the hair had been removed with scissors. Infection was produced when a culture suspension was lightly applied to an area of skin after the hair had been removed and hungry *Stomoxys* had been allowed to feed for about 30 minutes. Both *M. domestica* and *C. erythrocephala* transmitted the disease when brought into contact with the cauterised skin of goats immediately after having fed on incisions in carcases of goats that had died of the disease. *C. erythrocephala* and *Sarcophaga* sp. both failed to effect transmission in one experiment each in which they were brought into contact with cauterised skin 15 minutes after feeding on an infected carcase. Anthrax was not produced by bringing similarly infected adults of *M. domestica* into contact with the eyes of healthy goats immediately or after 15 minutes. No transmission was effected by adults of *C. erythrocephala* bred from larvae reared on meat from carcases of animals that

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had died of anthrax, and anthrax organisms were not recovered from the flies or from larvae about to pupate.

No evidence was obtained of the presence of anthrax bacilli in the mouth-parts of *S. calcitrans* killed at various intervals after their infecting feed, except in two instances in which very small numbers were demonstrated in flies killed within a few minutes of feeding. Bacilli were found in the bodies of such flies up to 72 hours after feeding. Anthrax organisms were found in the faeces of *S. calcitrans* deposited not less than 21 hours and not more than 72 hours after the infecting feed.

DE VRIES (A. H.) & DE KLERK (J. C.). **Control of Blowfly on Merino Sheep. Classification of Types as a Measure in breeding less susceptible Sheep.**—*Fmg in S. Afr.* Aug. 1944 repr. no. 78, 11 pp., 14 figs., 1 ref. Pretoria, 1944.

Descriptions and illustrations are given of the three classes of Merino sheep (A, B and C) distinguished according to fold-formation and breech conformation [*cf. R.A.E.*, B **28** 103; **32** 232] as having low, intermediate or high susceptibility to blowfly infestation. The importance of using only class A rams for breeding is stressed. Examination of 483 rams at a sale at Bloemfontein in August 1943 showed that only 41 were in class A, 277 were in class B, and 165 were in class C and unfit for service from the point of view of blowfly control.

Attention is drawn to the care that must be exercised to determine the class of long-woolled rams and to the necessity for ascertaining that Mules' operation has not been performed on a ram that is apparently plain-breeched. It is recommended that preliminary classing should be carried out when lambs are 4–6 months old to eliminate class C rams and that the classification of the others should be confirmed or revised at the two-toothed or teeth-shedding stage.

ALICATA (J. E.) & CUCKLER (A. C.). **Studies on the cecal Worm (*Subulura brumpti*) of Chickens.**—*Rep. Hawaii agric. Exp. Sta. 1942–44* pp. 105–107. Honolulu, 1945.

Notes based on observations in Hawaii are given on the life-history and intermediate insect hosts of *Subulura brumpti*, a caecal parasite of domestic fowls [*R.A.E.*, B **29** 15; **32** 69; **33** 145], and on its possible pathogenicity, together with an account of experiments on the value of crude naphthalene for the control of *Alphitobius diaperinus*, Panz., which is commonly found feeding on poultry droppings and is considered the most usual carrier of the Nematode. Tests in which granulated naphthalene was spread on a half-inch layer of earth in dishes 3 ins. high and 9·5 ins. in diameter, each containing 100 beetles and covered with mosquito netting, showed that a dosage of 4–5 gm. per dish caused complete mortality in 1–2 days. Under field conditions, 5 gm. crude naphthalene per sq. ft. of beetle-infested ground under a poultry house killed a large number of beetles in two days, but many survived under large portions of encrusted droppings. Eggs of *S. brumpti* were found to remain infective to beetles when kept in dried fowl droppings for seven months.

LEVER (R. J. A. W.). **Annual Report of Entomologist for 1944.**—*Agric. J. Fiji* **16** no. 3 pp. 87–88. Suva, 1945.

Nearly all the information in the brief section of this report that deals with mosquitos in Fiji has already been noticed [*R.A.E.*, B **33** 138–139, 188]. Distributions of *Gambusia* and *Anisops cleopatra*, Dist. [*cf.* **31** 185] were made, as both are useful predators of mosquito larvae. *Culicoides mollis*, Edw., and *Simulium jolyi*, Roub., were pests during the year. *Hister* (*Pachylister*) *chinensis*, Quensel, was sent to Taveuni and to Australia as a predator against *Siphona* (*Lyperosia*) *exigua*, de Meij.

LEVER (R. J. A. W.). **Entomological Notes.**—*Agric. J. Fiji* **16** no. 3 pp. 88–90, 8 refs. Suva, 1945.

The author states that comparison of mosquitos taken in Fiji in 1940 and identified as *Aëdes vigilax*, Skuse [*R.A.E.*, B **29** 89] with a series of this species taken by him in New Caledonia in 1945 showed that the Fijian specimens were in reality *A. vexans*, Mg. Characters distinguishing the two species are tabulated. There is no other record of *A. vigilax* from Fiji. A parasite reared from pupae of *Musca domestica* [*vicina*, Macq.] and *Sarcophaga* spp. in cow dung and from pupae of *Dacus passiflorae*, Frogg., has been identified as *Pachycrepoideus dubius*, Ashm., a Pteromalid not previously recorded from Fiji. Its development took 16–17 days.

[PRONEVICH (T. A.).] **Проневич (Т. А.). Contribution to the Biology, Ecology and specific Composition of the Family Simuliidae of the central Part of the northern Slopes of the Caucasus Mountains.** [*In Russian.*]—*Trav. Sta. biol. Caucase N.* **4** fasc. 2–3 pp. 13–16. Dzaudjikau, 1945.

Observations in 1940–41 in four mountain streams in the Redant Valley, about 5 miles from Dzaudjikau (former Vladikavkaz), showed that the only Simuliid that bred in them was *Simulium ornatum*, Mg., var. *caucasicum*, Rubtzov. It overwintered as a partly grown larva and had three generations a year, the adults of which oviposited in April–May, July–August and September–October. The development of the two summer generations did not proceed at the same rate in all the streams, probably owing to differences in temperature, but the overwintering generation developed more regularly, so that the streams were completely free from the aquatic stages for a certain period in spring.

The eggs were laid in small groups, chiefly on submerged leaves of grasses and other plants, and sometimes directly on the soil on parts of the bank exposed to slight wave action. Heavy rains were unfavourable for oviposition, and eggs covered with a layer of mud did not hatch. The egg stage lasted 4–5 days. The larvae and pupae attached themselves to completely or partly submerged leaves, chiefly of grasses and *Ranunculus aquatilis*, and stones. Their distribution in the stream depended on the speed of the current and the temperature and oxygen content of the water. They were commonest in the lower half of the stream, particularly at the mouth, and larvae that hatched in the upper part of the stream migrated to the lower part [*cf. R.A.E.*, B **34** 110]. This was probably due to temperature or to the fact that the oxygen content of the water was higher near the mouth of the stream. The larvae preferred relatively warm water, and those that had overwintered did not pupate before March, when the water reached a temperature of 12–13°C. [53·6–55·4°F.]. Most of the larvae and pupae occurred where the water flowed at a rate of about 2 ft. per second, as the oxygen content was higher than where there was less current. They disappeared from one of the streams at periods when it became muddy, probably because the mud clogged their respiratory filaments.

A list is given of ten other species of *Simulium* that were observed breeding on the northern slopes of the central part of the Caucasus Mountains; several of these were undescribed.

[KALUGIN (S. G.).] **Калугин (С. Г.). Contribution to the Study of Gadflies (Tabanidae) of the central Part of the northern Slopes of the Caucasian Mountain Range.** [*In Russian.*]—*Trav. Sta. biol. Caucase N.* **4** fasc. 2–3 pp. 21–25. Dzaudjikau, 1945.

Observations on the bionomics of Tabanids, which are the most numerous of the blood-sucking Diptera that attack domestic animals in the plains and foothills of the northern Caucasus, were made in and near the Redant valley.

Adults and larvae were collected in the valley itself, on the slopes of the mountains, in pastures and in swampy meadows. The best means of rearing larvae in the laboratory, where the temperature ranged up to 28°C. [82·4°F.], was to keep them in containers with moss on a layer of sand under about an inch of water. The percentages of larvae that gave rise to adults were 85 under these conditions, 75 or 60 when water with either sand or moss alone was used, and 20 or 15 when the water was about 3 ins. deep and algae or sand and algae was provided. No adults were obtained from larvae kept in water on cotton-wool, which interfered with their movements.

A list is given of species found in the district; the most numerous were *Tabanus unifasciatus*, Lw., *T. bromius bromius*, L., *Chrysops caecutiens ludens*, Lw., *Haematopota* (*Chrysozona*) *pluvialis*, L., and *H.* (*C.*) *hispanica*, Szil. Adults of different species began to emerge on different dates between mid-May and late June and were present for considerable periods, flights of *C. caecutiens ludens* and *T. unifasciatus* continuing for about two months. The flies were most active in July and the first half of August and disappeared in September. They rested on trees and shrubs during rainy, dull or windy weather, but certain species, including *H. pluvialis*, preferred to rest on grasses, and those in the foot-hills also sheltered in cracks in rocks.

The larvae occurred chiefly in cold streams fed by springs and were found in shallow places and in mud where the stream was overgrown with *Ranunculus*. They preferred muddy soil or fine sand to gritty or pebbly ground, and most of them were on or near the surface in August and at a depth of about an inch in December at a temperature of 8°C. [46·4°F.]. They did not occur in water more than 34 ins. deep and were not common at this depth, even when other conditions were favourable. Migration in search of sites for pupation was first observed on 18th April, and the last pupae (of *H. pluvialis*) were found on 4th August. Pupae of *C. caecutiens ludens* usually occurred in damp sites close to the water, whereas those of *T. unifasciatus* and *T. bromius* were found at distances of up to 20 ft. from the water, chiefly in sandy banks. The numbers of newly emerged adults of these two species caught in emergence boxes placed on the banks of a stream about a yard from points that had been inhabited by the larvae were greatest on sand mixed with pebbles, rather less on sand containing a few roots of plants, and 50 per cent. less in places with a dense growth of roots.

SPENCER (G. J.). **Mental Insect Attacks.**—*Proc. ent. Soc. B.C.* **42** pp. 15–16. Vernon, B.C., 1945.

A brief account is given of three cases of mental fixation or hallucination brought to the author's notice in British Columbia over a period of eighteen years, in each of which the sufferer (a man living alone) imagined himself to be persecuted by small fast-flying tick-like insects. In one instance, the insects were alleged to burrow under the skin, causing intense irritation. W. Downes reported the case of a woman who imagined that she was being bitten by small flies, particularly at night. The use of a mosquito repellent was recommended and gave relief, but the trouble returned, disappearing eventually after treatment for neurasthenia. J. D. Gregson received a complaint from a man in Alberta that ticks were burrowing under his skin. The doctor who was treating him reported that the affliction was yielding slowly to a mixture taken by mouth and abundant reassurance that the treatment would be effective. The men had earlier been attacked by ticks in British Columbia.

SCHOOF (H. F.). **Entomology in Malaria Control.**—*J. econ. Ent.* **38** no. 5 pp. 517–522, 7 refs. Menasha, Wis., 1945.

The functions of the entomologist in malaria control are discussed, and examples are given from work in North Carolina. The entomologist is responsible for determining whether Anopheline control is necessary, providing the

information on which the work is based, and evaluating the effectiveness of the measures taken. Examples are given of the saving effected by directing control measures only against species of *Anopheles* shown by entomological research to be concerned in transmission in the area in question and by delaying the beginning of oiling in spring until the vector has started to breed. Emphasis is laid on the importance of concentrating attention on practical problems.

MAGY (H. I.) & HOSKINS (W. M.). **Some Dinitrophenol Derivatives as Mosquito Larvicides.**—*J. econ. Ent.* **38** no. 5 pp. 524–527, 1 graph, 2 refs. Menasha, Wis., 1945.

No ovicidal action was found when eggs of *Culiseta incidens*, Thoms., floated for as long as three days before hatching on solutions containing up to 126 mg. per litre of 3,5 dinitro-o-cresol [numbered with CH_3 as 1] or 2,4 dinitro-6-cyclohexylphenol or up to 82 mg. of the dicyclohexylamine salt of the latter. Solutions of the cresol were not toxic to first-instar larvae of *C. incidens* at any practical concentration, and the phenol and its salt only at relatively high concentrations (approaching 100 mg. per litre). In experiments with fourth-instar larvae, low mortalities were obtained with each compound in solution. However, complete mortality of fourth-instar larvae occurred in two hours in solutions containing 82 mg. of the dissolved phenol per litre with 7·5 mg. per litre in suspension, and 81 and 94 per cent. mortality occurred in 24 hours in solutions containing 96 and 95 mg. of the dissolved salt per litre with 4·4 and 15·4 mg. in suspension, respectively. It is therefore concluded that the compounds act as stomach rather than contact poisons. The solubility of dinitro compounds increases with alkalinity. The absorptive region of the digestive tract of *C. incidens* was shown to be sufficiently alkaline to ensure solution of ingested particles.

In field trials in California of dusts applied in the weeds and reeds along an irrigation ditch, dusts containing 10 per cent. of the phenol or 40 per cent. of its salt, each at 50 lb. per acre, gave high mortality of larvae of a subspecies of *Anopheles maculipennis*, Mg. The former killed large numbers of predators, but the latter apparently did not harm them.

DETHIER (V. G.). **The Transport of Insects in Aircraft.**—*J. econ. Ent.* **38** no. 5 pp. 528–531. Menasha, Wis., 1945.

Data are given on the number of insects of each of 86 families taken between December 1943 and April 1945 in 816 samples from aeroplanes at various landing points in central Africa on the route between India and the west coast of Africa. All aircraft were sprayed before landing, and all insects collected were dead or dying. The insects found varied with the season and the immediate environment in which the aircraft had been parked but extremely little with change of locality. Diptera comprised 88·5 per cent. of the total. Only Muscids were represented by more than 150 individuals; there were 1,246 of these and 10 mosquitos. There was no evidence that insects could enter aircraft in flight; airflow and slipstream direct most away from the aeroplane. They enter aircraft on the ground by flying or are carried in on people or cargo. Most are found in the cabins, as they have the largest ports of entry and offer attractive odours and conditions. Control should therefore be concentrated on them. The only insects found in the wing and tail spaces were a few Muscid flies, and there is little likelihood of their escape from them. No insect was recovered from the engine nacelles, in which dust, oil and grease exert some repellent effect, and adults of *Anopheles gambiae*, Giles, caged in nacelles during test flights failed to survive.

Observations showed that the incidence of insects in aircraft is reduced by parking the aeroplanes away from the edges of jungles, fields or water courses,

and by taking suitable action at airports. At one airfield with an effective malaria control programme, no Anophelines were found to enter aircraft over a period of 18 months. Aerosol bombs gave adequate control in cabins.

EIDE (P. M.), DEONIER (C. C.) & BURRELL (R. W.). **DDT as a Culicine Larvicide.**—*J. econ. Ent.* **38** no. 5 pp. 537–541, 1 ref. Menasha, Wis., 1945.

An account is given of early tests of the effectiveness of DDT as a mosquito larvicide. They were made in Florida and begun in March 1943. Against a population consisting mainly of *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) in rain-water barrels, phenothiazine used as a standard of comparison was not satisfactory as a dust, but applied in alcohol so that a suspension was formed, it was effective for 2–3 months at 20 parts per million parts water and for 21–25 days at 10 p.p.m. DDT gave good results as a dust at these heavy dosages, though in some tests there was no kill until some of the dust was made to sink. In one barrel, breeding was not resumed for a year. Results with suspensions produced by applying DDT in a water-miscible solvent were equally good and more consistent. A concentration of one part DDT per million parts water, applied in acetone, gave complete control for 138 days. In comparative tests against the same species, in which applications were made at 0·05–5 parts DDT per million parts water, the suspension produced by 10 per cent. DDT in 80 per cent. cellosolve (ethylene glycol monoethyl ether) and 10 per cent. Nopco 1216 (sulphonated sperm oil) was slightly more effective than the emulsion produced by a concentrate of 20 per cent. DDT, 60 per cent. xylene and 20 per cent. Triton X-100 (an aralkyl polyether alcohol), but the difference was not great and the emulsion is generally recommended because it contains a higher concentration of DDT. Its effectiveness was not altered by varying the concentration of emulsifier between 6·6 and 20 per cent.

The effectiveness of applications of DDT on ponds and marshes varied with the species of mosquito present. A suspension from a cellosolve solution was toxic to *C. pilosus*, D. & K., *C. nigripalpus*, Theo., *C. salinarius*, Coq., and *Uranotaenia* sp. for 11 weeks at 2 p.p.m., for five weeks at 1 p.p.m., and for less than one week at 0·1 p.p.m. In only one test did a suspension fail to give complete mortality at this or a higher concentration. The concentrates were mixed with water at a rate to give 10 U.S. gals. total spray per acre. Comparison of the initial kill effected by the suspension and emulsion under a variety of conditions in natural breeding places showed that the suspension gave complete kill of all species (*Aëdes taeniorhynchus*, Wied., *A. sollicitans*, Wlk., *C. nigripalpus* and *Culex* sp.) at 0·1 and 0·05 part DDT per million parts water. The xylene emulsion was completely effective against *Culex* at 0·025, 0·05 and 0·1 part DDT per million, against *Psorophora confinnis*, Lynch, and *P. ciliata*, F., at 0·025 p.p.m., and in one test against *A. taeniorhynchus* and *A. sollicitans* at 0·1 p.p.m. A few larvae of *Aëdes* were alive after 24 hours in two tests with 0·1 and 0·05 p.p.m., but they were noticeably affected. Complete mortality of *Culex* sp. was obtained in one test with the amount of xylene emulsion calculated to give 0·0125 p.p.m. DDT throughout the depth of the pond, but it was later found that the emulsion was concentrated at the surface.

A 20 per cent. dust of DDT in talc at 0·1 and 1 lb. DDT per acre gave very poor control of *A. taeniorhynchus* and *A. sollicitans* in a salt-marsh drainage ditch. A 1 per cent. dust at 1 lb. DDT per acre gave the best results in this habitat but did not kill all larvae. *P. ciliata* and *C. salinarius* were controlled by 20 per cent. DDT dust at 1 lb. DDT per acre. Petroleum oil containing 1–5 per cent. DDT gave complete control of *C. salinarius* at 0·1 lb. DDT per acre in ponds filled with various types of vegetation. Fuel oil without DDT at 1·2 U.S. gals. per acre killed 0–85 per cent. of larvae of *C. salinarius* according to the type of vegetation.

LINDQUIST (A. W.), MADDEN (A. H.), HUSMAN (C. N.) & TRAVIS (B. V.). **DDT dispersed from Airplanes for Control of adult Mosquitoes.**—*J. econ. Ent.* **38** no. 5 pp. 541–544, 2 figs., 1 ref. Menasha, Wis., 1945.

Tests on small plots in densely wooded areas in Florida in June 1943 showed that finely atomised sprays, aerosols and dusts containing DDT were highly effective against salt-marsh mosquitos when applied with hand equipment on the ground. This led to studies on dispersing DDT from aeroplanes. An account is given of tests made against adults of *Aëdes taeniorhynchus*, Wied., with a small aeroplane in dense bush and mangrove growths on the Keys in November and December 1943. Sprays containing 5 per cent. DDT in an emulsion or in solution in kerosene, fuel oil or 25 per cent. motor oil in kerosene, dispersed at 2–3 U.S. quarts per acre, reduced populations by 69–99·5 per cent. in 24 hours. Control was over 95 per cent. in half the tests, but strong winds and perhaps other factors made it lower in others. The lower rate of application was as effective as the higher one, and the emulsion and solutions were about equally effective. Infiltration of mosquitos into the treated area probably made the reduction of population, as estimated by a count after 24 hours, appear less than it actually had been. These results suggested that DDT sprays might be applied from aircraft to control infected disease vectors ahead of advancing troops.

Dusts containing 5 per cent. DDT in talc or kaolin gave no appreciable control of adult mosquitos when dispersed from an aeroplane at about 5 lb. per acre over similar growth. A combination smoke and spray produced by injecting 20 per cent. DDT in cyclohexanone and motor oil into a specially constructed exhaust pipe of an aeroplane [*cf. R.A.E.*, B **34** 99] and releasing at 2 U.S. quarts per acre gave 98 per cent. control, but 5 per cent. DDT in motor oil was ineffective.

LINDQUIST (A. W.) & MCDUFFIE (W. C.). **DDT-oil Sprays applied from an Airplane to control *Anopheles* and *Mansonia* Mosquitoes.**—*J. econ. Ent.* **38** no. 5 pp. 545–548, 2 refs. Menasha, Wis., 1945.

Sprays containing 10 per cent. DDT in cyclohexanone and oil were dispersed at 2 U.S. quarts (0·4 lb. DDT) per acre from a small aeroplane equipped with a portable spray unit over jungle forest areas in the Panama Canal Zone in two tests carried out in calm weather during 1944. In one test, populations of *Anopheles* (predominantly *A. albimanus*, Wied.) were reduced by 98–100 per cent. and those of *Mansonia* spp. (*M. titillans*, Wlk., *M. nigricans*, Coq., and *M. fasciolata*, Arrib.) by 97–99 per cent. during the four days following spraying. Some infiltration had taken place six days after spraying, and a reduction of 70–71 per cent. of *Mansonia* and 76–78 per cent. of *Anopheles* was indicated. By the 21st day, there were as many mosquitos in the treated areas as elsewhere. Larvae of *A. albimanus* and *Culex* were killed by the spraying, and breeding was not resumed for a week. The second test was made when the foliage was wet. Anopheline populations were reduced by 90–98 per cent. during the first two days after spraying and *Mansonia* by 87–98 per cent. After this the test was discontinued. These tests confirm the results of earlier ones [see preceding abstract] and are the first to show the effectiveness and practicability of spraying jungle forests from aircraft for the control of adult mosquitos, especially malaria vectors, under certain military conditions.

BLAKESLEE (E. B.). **DDT Surface Sprays for Control of Stablefly Breeding in Shore Deposits of Marine Grass.**—*J. econ. Ent.* **38** no. 5 pp. 548–552, 3 refs. Menasha, Wis., 1945.

The following is mainly based on the author's summary. Tests made during 1944 showed that light surface sprays containing technical DDT or DDT

residual oil (a dark brown syrupy liquid obtained as a by-product in the manufacture of DDT) can be effectively used for the control of *Stomoxys calcitrans* L., breeding in deposits of marine vegetation on beaches or bays in Florida [*cf. R.A.E.*, B **30** 60]. The sprays consisted of stock solutions of the DDT or residual oil in xylene, with Triton X-100 as the emulsifier, diluted with bay water. Small-plot tests showed the DDT to be about five times as toxic as the residual oil. Sprays containing 0·5 per cent. DDT or 2·5 per cent. of the residual oil, applied at 2 U.S. gals. per 100 sq. ft. to weed already infested, caused 90–95 per cent. mortality of emerging adults. The deposits of DDT and DDT residual oil from these sprays were 380 mg. and 1,900 mg. per sq. ft., respectively. When DDT was applied at the same concentration and dosage to uninfested green weed not subjected to tidal washing, breeding was prevented until the weed was too old to support it to any appreciable extent [**33** 148]. Mortality in infested weed treated and subjected to tide washing was about 90 per cent. and was due to the combined effect of the spray and tidal submergence. Beach tests, in which the sprays were applied in a manner simulating practical procedure, gave an indicated control of 84 per cent. on heavily tide-washed material and 99–100 per cent. control on deposits not subjected to tidal action. Eggs present on the weed at the time of spraying did not give rise to adults.

In these tests and in practical control operations, 41 miles of weed deposit on 75 miles of shore were treated with 7,545 U.S. gals. dilute spray at rates varying from 100 to 600 U.S. gals. per mile. It is concluded that 200 U.S. gals. per mile is sufficient for average conditions. DDT is much less expensive to use than creosote sprays [**31** 95] and more convenient, as it can be applied from shallow-draft boats.

Smith (C. N.) & Gouck (H. K.). **DDT to control Ticks on Vegetation.**—*J. econ. Ent.* **38** no. 5 pp. 553–555, 1 ref. Menasha, Wis., 1945.

Soluble pine oil (a commercial pine oil containing an emulsifier) was found to be satisfactory in the preparation of DDT sprays for the control of ticks. In preliminary laboratory tests, an emulsion made with the soluble pine oil was slightly less effective against unfed adults of *Amblyomma americanum*, L., and *Dermacentor variabilis*, Say, at low concentrations than one made from plain pine oil with the addition of Areskap (sodium monosulphonate of butylphenylphenol), but the two were equally effective at the strength used in the field and the former was more stable. It was therefore used in field tests.

Sprays containing 0·96 oz. DDT (technical grade) dissolved in 4·8 fl. oz. of the soluble pine oil and emulsified in water to make 15 U.S. gals. gave highly satisfactory control of nymphs and adults of *A. americanum* in woodland plots in Georgia when applied at 6 oz. DDT per acre. Populations of nymphs and adults were 6 per cent. or less of their original numbers for 68 and 15 days, respectively, as compared with up to 278 and 237 per cent. in the untreated area, and the adult population increased to a peak of only 59 per cent. as compared with 637 per cent., in 53 days. The entire surface of the ground and all vegetation up to 3–4 ft. above ground level were covered with spray. No injury to plants was apparent. Dust containing 5 per cent. DDT in pyrophyllite applied at 3 lb. DDT per acre kept nymphs and adults of *A. americanum* to 3 and 8 per cent., respectively, of their original numbers for 46 days, whereas abundance in control plots increased to 136 and 302 per cent., respectively. A dust with 1 per cent. DDT and a spray both applied at 5 oz. DDT per acre were much less satisfactory, particularly the dust. A spray containing 1·9 oz. DDT, 9·6 fl. oz. soluble pine oil and water to make 15 U.S. gals., with or without the addition of 9·6 fl. oz. 40 per cent. nicotine sulphate, applied at 1 lb. DDT per acre gave excellent control of nymphs and adults of *A. americanum*, but the nicotine sulphate increased the speed of action considerably. With it, the abundance of nymphs did not exceed 1 per cent. of the original number and

that of adults did not exceed 4 per cent. for 37 days, while in the control plots, their numbers increased to 183 and 215 per cent., respectively. When a dust containing 1 per cent. DDT and one containing 3 per cent. rotenone were applied at 4 oz. DDT and 8 oz. rotenone per acre, respectively, neither gave satisfactory results. It is concluded that DDT at 1 lb. per acre will control nymphs and adults of *A. americanum* for more than a month, possibly for the whole season of activity. Many attempts to reinfest sprayed areas were unsuccessful.

A spray of 9·6 oz. DDT and 48 fl. oz. soluble pine oil in water to make 15 U.S. gals., applied at 7 lb. DDT per acre, and this spray with the addition of 9·6 fl. oz. 40 per cent. nicotine sulphate, applied at 9 lb. DDT per acre, gave more than 99 per cent. control for ten days of adults of *D. variabilis* on roadside plots in Massachusetts, and a dust of 5 per cent. DDT in pyrophyllite applied at 3 lb. DDT per acre gave more than 90 per cent. control. A much lighter application of spray would probably be satisfactory.

Telford (H. S.). **New Insecticides for Chicken Lice Control.**—*J. econ. Ent.* **38** no. 5 pp. 573–576, 22 refs. Menasha, Wis., 1945.

The effectiveness of 37 dusts for the control of poultry lice was compared in tests carried out on hens naturally infested with *Eomenacanthus stramineus*, Nitzsch, and *Menopon gallinae*, L., and, in some instances, *Goniocotes gallinae*, Retz. (*hologaster*, Nitzsch) also. The dusts were applied with a shaker at 5·1–11·8 gm. per bird. The diluent used was generally Pyrax [pyrophyllite]. Treated birds were kept under observation for 5–7 days. Preparations that kept them free of lice for this period were considered to have "residual" or lasting effect, whether the result was achieved through the killing of the eggs or through the action of a toxic deposit in the feathers on newly hatched lice.

The results are given in detail in a table. Those for three substances have already been noticed [*R.A.E.*, B **33** 109]. Relatively quick action and lasting properties were shown by DDT at 0·5–4 per cent., 10 per cent. derris (containing 5 per cent. rotenone), 10 per cent. tetramethylthiuram disulphide, 2 per cent. of a mixture of tetramethylthiuram monosulphate and disulphide (9 : 1) and powders containing 30 per cent. micronised wettable sulphur mixed with either 5 per cent. Lethane B-71 [14 per cent. aliphatic thiocyanate], 5 per cent. Thanite [a secondary terpene alcohol thiocyanyl acetate], 5 per cent. phenothioxine, 5 per cent. NH dust [which contains pyrethrum marc and a nitrated hydrocarbon], or 5 per cent. diphenyl. Micronised wettable sulphur, 33 per cent. sodium fluoride and 30 per cent. Kryocide (cryolite) were all highly effective but slow. The duration of effectiveness of three promising preparations was determined by placing treated hens, freed of lice, in an infested flock. Six birds dusted with 4 per cent. DDT had louse infestations approaching their original population within 30–34 days. Micronised wettable sulphur gave longer protection, but 33 per cent. sodium fluoride was less lasting. Thanite at 5 per cent. and Lethane B-71, phenothioxine, NH dust and o-nitrodiphenyl, each at 10 per cent., were relatively quick acting but their effect was not lasting. Unsatisfactory results were given by 15 per cent. sodium fluoride, 0·5 per cent. fixed nicotine (Black Leaf 155), 0·25 and 0·125 per cent. DDT, 30 per cent. Genicide (xanthone), 5 per cent. 2,4-dinitro-6-cyclohexylphenol, 10 per cent. sabadilla, 2 per cent. 2,4-dinitroanisole, a mixture of 2 per cent. dinitroanisole and 2 per cent. IN-930 (N-isobutylundecylenamide), 10 per cent. orthophenylphenate, and a mixture of 2 per cent. diphenyl and 5 per cent. Velsicol AR-50 (a polymethylated naphthalene).

A proprietary louse powder containing 0·066 per cent. pyrethrins, 30 per cent. sulphur, 5 per cent. naphthalene, 0·45 per cent. petroleum hydrocarbons and 64·48 per cent. inert ingredients was relatively quick acting and lasting when undiluted, but unsatisfactory at concentrations of 50 or 25 per cent. in pyrophyllite.

Thurman jr. (D. C.). **The bloodsucking Habits and Growth of Nymphs of** *Triatoma gerstaeckeri*.—*J. econ. Ent.* **38** no. 5 p. 597, 1 fig. Menasha, Wis., 1945. **The Biology of** *Triatoma gerstaeckeri*.—*T.c.* pp. 597–598, 1 ref.

In the first paper, average and maximum figures obtained in experiments by the author are given for the amount of blood taken by nymphs of *Triatoma gerstaeckeri*, Stål, in the first feed of each instar, the percentage gain in weight after this meal and the percentage of blood in the fed bug, and an average daily increase in body weight is calculated for each instar.

The second paper deals with studies on the bionomics of *T. gerstaeckeri* made from June 1942 to December 1943 with several hundred bugs. The average number of eggs per female in a season (April to October 1943) was 245·35. The incubation period was 15–18 days. Mortality is highest during the first days of the first instar. At laboratory room temperature and humidity, the five instars lasted 15–33, 16–33, 26–63, 32–65 and 60–120 days, respectively, and adults lived 6–12 months. It was not determined whether females may lay fertile eggs through two seasons. The geographical and seasonal distribution of *T. gerstaeckeri* in Texas are discussed. Hot summer and autumn weather apparently lengthens the time spent in the last instar, though nymphs of the earlier instars grow well if they can obtain frequent blood meals.

Carpenter (S. J.), Chamberlain (R. W.) & Baker (R.). **Flea Collections at Army Installations in the Fourth Service Command.**—*J. econ. Ent.* **38** no. 5 pp. 600–602. Menasha, Wis., 1945.

Records are given of seven species of fleas taken on rats, dogs and cats and in buildings in 22 localities in the States of the Fourth Service Command (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina and Tennessee) in 1943–45 showing the date and locality of collection, the number and sex of the examples found and usually the host or habitat. *Xenopsylla cheopis*, Roths., was taken on rats in Alabama, Florida, Georgia and South Carolina.

Olson (T. A.) & Dahms (R. G.). **Control of Housefly Breeding in partly digested Sewage Sludge.**—*J. econ. Ent.* **38** no. 5 pp. 602–604. Menasha, Wis., 1945.

Musca domestica, L., does not breed in sewage sludge when the plants operate under optimum conditions, but if the sludge has to be withdrawn before it has been completely digested, it provides an excellent breeding medium. In a test of treatments for the control of such breeding, larvae were reared to the third instar in a mixture of ground whole oats, ground lucerne and wheat bran (1 : 2 : 5) moistened with a solution of one teaspoonful each of dried yeast and Maltine (a concentrated extract of malted barley and of wheat and oats) in one litre of water. They were then placed in jars containing a mixture of equal parts of completely and incompletely digested sludge, from which some of the water had been drained, and the contents of four jars were treated with each preparation and four were left untreated. Emulsions containing 0·05 per cent. rotenone or 0·25 per cent. DDT applied at 2·93 U.S. gals. per 100 sq. ft. or 0·15 U.S. gal. per cu. ft. gave no control, but kerosene and a 30 per cent. solution of borax at the same rate both killed all larvae. A dust of 10 per cent. DDT in talc at 14·77 lb. per 100 sq. ft. or 0·75 lb. per cu. ft. was only moderately effective as a larvicide, but very few adults emerged from the pupae produced and all these died within two hours. Control was not substantially improved by stirring the larvicide into the sludge.

An additional test of the 10 per cent. DDT dust was made against flies developing in the culture medium. When it was applied at 0·97 lb. per 100

sq. ft. or 0·05 lb. per cu. ft., 88·1 per cent. of the larvae pupated and 43·4 gave rise to adults, all of which died within two hours. With double the dosage, 91·6 per cent. of the larvae pupated and 21·3 per cent. gave rise to adults, all of which died within two hours. Among controls, 95·3 per cent. of the larvae gave rise to flies that survived.

KULASH (W. M.) & MAXWELL (J. M.). **DDT and Bedbugs in Chicken Houses.**—*J. econ. Ent.* **38** no. 5 p. 606, 2 refs. Menasha, Wis., 1945.

The walls, roost, dropping board and exposed portions of feeding boxes of four fowl houses in North Carolina heavily infested with *Cimex lectularius*, L., were sprayed with a solution of 5 per cent. DDT in kerosene on 3rd April 1945. In three houses, the nesting material was removed from the nesting boxes, which were of wood, before they were sprayed. In the fourth house, the nesting boxes were wire-bottomed and the nesting material was not removed. One living nymph and two living adults were found in 20 nesting boxes one month after treatment, but no living bugs of any stage after two months. Before treatment, 380 bugs, mostly nymphs, had been found in the nesting material from one box. No living bugs were found in the house in which the nesting material was treated in place. The DDT had no adverse effect on the fowls, but a number of dead or dying mice were found after it had been applied, whereas none was observed before.

HAVILAND (E. E.). **The Effect on the Fingers of the Poison of *Formica exsectoides*.**—*J. econ. Ent.* **38** no. 5 p. 607. Menasha, Wis., 1945.

When *Formica exsectoides*, Forel, is handled during the winter, the skin of the tips of the fingers becomes hardened, and peels off after a few days. If there are abrasions on the skin, a burning sensation is produced. A much more severe reaction followed the handling of some 1,200 workers during one day in spring. The ants ejected poison quickly and freely. The tips of the first finger and thumb soon became yellow, stiff, numb and painful, light pressure continued to cause discomfort for five hours, and the thumb and first finger still felt bruised the next day. The skin sloughed off on the sixth day. An irregular purple line that developed below the junction of nail and skin persisted for 18 days.

LINDQUIST (A. W.) & MCDUFFIE (W. C.). **DDT residual Spray Tests in Panama.**—*J. econ. Ent.* **38** no. 5 p. 608, 1 ref. Menasha, Wis., 1945.

In April 1944, tests were made in Panama of the effectiveness of sprays of DDT applied to leave a toxic residue for the control of *Anopheles albimanus*, Wied. The temperature at the time of the first cage test was 83°F. and the relative humidity about 70 per cent. Of some 50 adults 1–4 days old placed in the cage, which had been sprayed 37 days previously with DDT at 200 mg. per sq. ft., half were knocked down in 12 minutes and all in 28 minutes. When the test was repeated three days later with females two days old, half were knocked down in 18 minutes and all were dead [*sic*] in 26 minutes. Females two days old exposed in the cage for ten minutes and then transferred to a clean jar were all down in 38 minutes. When the same cage was tested against *Anopheles quadrimaculatus*, Say, in Florida 14 days later at 80°F. and a relative humidity of 78 per cent., half were down in 27 minutes and all in 47 minutes. As previous work had shown that an interval of 14 days does not appreciably decrease the speed of the toxic action of DDT on wire-gauze cages, it is concluded that *A. albimanus* is more susceptible to DDT than *A. quadrimaculatus*.

Observers sitting for 30 minutes in a jungle hospital tent (8×8×8 ft.) that had been sprayed on the inside with 1 U.S. quart 5 per cent. DDT in kerosene and subjected to natural weathering saw about 50 mosquitos of the genus

Mansonia and a few Anophelines enter. The tent was closed for 30 minutes and at the end of this time none of the mosquitos could fly. *A. albimanus* was observed to be a cautious biter, and habitually rested on a wall for several minutes when disturbed by a slight movement of the host as well as after obtaining a meal. Many females infected with malaria parasites might therefore be killed by the systematic spraying of dwellings in malarious areas, even though they do not habitually rest in houses. About 80 mosquitos (more than one-third of them *A. albimanus*) entered the tent in ten minutes 24 days after it had been sprayed ; 75 per cent. of them were knocked down within 30 minutes of the flap being lowered, and all were down two hours later. The DDT appeared to be as effective on the 32nd day as when first tested.

Lyle (C.) & Strong (R. G.). **Dusting for Cattle Lice.**—*J. econ. Ent.* **38** no. 5 pp. 611–612. Menasha, Wis., 1945.

The practicability of applying dusts for the control of lice on cattle by methods more rapid than hand application was investigated in the spring of 1945 in Mississippi on calves infested with *Linognathus vituli*, L., and *Damalinia* (*Bovicola*) *bovis*, L. Rings were clipped round three circles on each side of the body and the lice in these areas counted. The dusts used were 0·5 per cent. rotenone in equal parts Pyrax [pyrophyllite] and tripoli earth and 10 per cent. DDT (Neocid A-10). In the first test, in which the rotenone dust was used, one calf was treated with a dust cloud until it was hidden by it, a second by blowing dust on its right side so that a little reached the left side, and a third by rubbing dust on the right side by hand. Of the lice in the circles, the first treatment killed all on both sides, the second all on the right and all but one on the left, and the third all on the right. Lice in long hair under the brisket of the first calf were not controlled ; there was none in this situation on the other calves. Reinfestation was not considerable until 24 days after treatment. In a second test, in which the DDT and rotenone dusts were blown over or against the sides of calves, all applications were light and kill was not satisfactory, particularly with DDT. In a third test with heavier applications, rotenone and DDT both gave complete control of lice when blown against the sides of the animals from a distance of about 3 ft., and DDT gave almost complete control as a cloud applied from about 6 ft. away, but rotenone was less effective on a much more heavily infested calf. The cloud was not thick enough to hide the animals, but gave them a dusty coating. It is concluded that DDT and rotenone dusts can be rapidly, economically and effectively applied with small plunger and fan dusters to dairy cattle infested with *L. vituli* and *D. bovis*. Better kills seem to be obtained when the dusts are blown directly against the animals, but fog applications heavy enough to give the coat a dusty appearance are also satisfactory. If the latter method is used, some dust should be blown under the animals to reach the long-haired areas. Dust containing 0·5 per cent. rotenone seems somewhat more effective than 10 per cent. DDT. Two applications should give almost complete control.

Parish (H. E.) & Rude (C. S.). **DDT for the Control of Goat Lice.**—*J. econ. Ent.* **38** no. 5 pp. 612–613, 1 ref. Menasha, Wis., 1945.

Infestation of Angora goats by lice reduces the quantity and quality of the mohair. Preliminary laboratory tests [*R.A.E.*, B **32** 205] and field tests carried out in 1944 and 1945 indicated that *Holakartikos crassipes*, Rudow (*Trichodectes hermsi*, Kellogg & Nakayama), *Damalinia* (*T.*) *caprae*, Gurlt, and *Linognathus stenopsis*, Burm., the three species of lice commonly found on goats in Texas, can be controlled with a dip containing 0·2 per cent. DDT and that the dip is effective on freshly sheared goats as well as on those with long hair. The dip was prepared by diluting 10 pints of stock solution consisting of 1 part DDT in 5 parts (by weight) soluble pine oil [**35** 24] in 100 gals. water. The

many hundred goats passed through this dip in the field tests were all completely freed of lice. There were no undesirable effects on the goats or the mohair. The mohair on dipped animals is glossy all the way to the skin. About 0·5 U.S. gal. dip per animal is needed for goats in full fleece and 0·19 U.S. gal. for goats that have just been shorn. The cost is discussed. The dip remained effective in an open vat after 99 days.

EDWARDS (G. A.) & PORTER (E. V.). **Mosquitoes of northwest Florida.**—*J. econ. Ent.* **38** no. 5 pp. 613–615, 1 fig., 2 refs. Menasha, Wis., 1945.

Data are given on the abundance and seasonal distribution of various species of mosquitos taken as adults in the vicinity of Valparaiso, Florida, between May 1943 and June 1945, inclusive. All the species taken had already been recorded for Florida.

LINDGREN (D. L.) & SINCLAIR (W. B.). **Sorption of HCN by Insect Pupae.**—*J. econ. Ent.* **38** no. 5 p. 617, 1 graph, 3 refs. Menasha, Wis., 1945.

The toxicity of a fumigant to insects depends on the chemical constitution of the compound and its physical and chemical properties in the gaseous phase, on the effect of temperature and relative humidity on both the fumigant and the insect, and on the physiology of the insect at different stages of development; even when two species of insects sorb the same amount of fumigant under identical conditions, the lethal dosage may be very different for the two species. Apart from the variation in tolerance of insects to a given fumigant, all these factors bear a definite relation to the sorption of the fumigant by the insect during the period of exposure, and as part of a study of the physical, chemical and physiological factors that affect the sorption of hydrocyanic acid gas by insects, the amounts sorbed by pupae of *Musca domestica*, L., at different ages were investigated. Samples of pupae from a single source were fumigated on successive days with 16·8 mg. HCN per litre for 40 minutes at a temperature of 75°F. and 48–78 per cent. relative humidity, and the HCN was recovered from them immediately. The amount recovered decreased from nearly 0·8 mg. per gm. of pupae on the first day (one day after pupation) to about 0·4 mg. on the third day, remained approximately constant until the fifth day and then increased steadily to 0·95 mg. on the eighth day, when the adults were about to emerge.

The amounts recovered were plotted on a graph, and the curve produced followed the mortality curve previously obtained for pupae of *Tribolium confusum*, Duv., of different ages when fumigated with a given concentration of chlorpicrin, to which they were least resistant at the beginning and end of the pupal stage and most resistant from the second to the fourth day [*cf. R.A.E.*, A **24** 777].

MUNSON (S. C.) & YEAGER (J. F.). **DDT-like Effects from Injection of other Compounds into Roaches.**—*J. econ. Ent.* **38** no. 5 p. 618, 1 ref. Menasha, Wis., 1945.

Molar concentrations of DDT and other compounds were injected into nymphs of *Periplaneta americana*, L., and the various compounds compared with DDT with regard to the symptoms produced and the speed of kill of the most effective doses. In the results that follow, the number given in brackets after the name of each compound is the reciprocal of the survival time for the most effective dose of the compound divided by the survival time of a corresponding dose of DDT, so that compounds that exceeded DDT in speed of kill have an index greater than unity. Symptoms very similar to those caused by DDT were produced by p-dichlorbenzene (1·08), hydroquinone in 1·1 per cent. sodium chloride (4·88), hydroquinone in maize oil (1·07), aniline (1·91) and phenol (1·47). Diphenylamine (1·52) and benzene (ca. 0·5) produced symptoms only

moderately like those caused by DDT. Symptoms not like those caused by DDT were produced by o-chlordiphenyl (0·13), dibenzyl (0·46), p-nitrophenol (3·3), toluene (0·1), benzoic acid (0·68), salicylic acid (0·35), xylene (0·12) and phenothiazine (8·63). Pyrogallol in 1·1 per cent. sodium chloride (1·13), p-phenylenediamine (1·2), alpha-naphthol (0·49), dimethyl-p-phenylenediamine (1·24) and tetrachlorhydroquinone (4·46–6·24) were intermediate in effect between the first and second groups and chloral hydrate (0·74), diphenyl (0·51) and tetrachlorbenzene (0·87) were intermediate between the second and third.

The values for speed of kill show that benzene was less effective than DDT but that a benzene ring with Cl, OH or NH_2 substituted in the para position could be as effective as DDT or more effective. The results are in agreement with the idea that the DDT molecule consists essentially of a toxic (aromatic) portion chemically combined with a carrier (chloral) portion, the latter being considered chiefly responsible for the penetration properties of the molecule [*cf. R.A.E.*, B **33** 76]. Minimum lethal doses, which were estimated for the more toxic compounds, seemed to be greater for compounds that were more soluble in water, suggesting that the more water-soluble compounds might be excreted more readily than the others. Some of the compounds are known to be oxidised by the cytochrome enzyme system, and the first three in the fourth group have long been used in the histochemical detection of indophenol (cytochrome) oxidase. These facts, together with the results given, suggest that an effect upon the cytochrome oxidase system in the insect might be a part of the mode of action of DDT.

DUMBLETON (L. J.). **" 666 " and " D.D.T." as Mosquito Larvicides.**—*N. Z. J. Sci. Tech.* **27** (A) no. 2 pp. 133–134. Wellington, N.Z., 1945.

Laboratory tests were made in New Caledonia of the comparative effectiveness of 666 [benzene hexachloride] and DDT, both applied in acetone solution, against third- and fourth-instar larvae of *Aëdes vigilax*, Skuse, in containers 6 ins. in diameter and 4½ ins. deep. All larvae were dead or moribund 24 hours after the application of either insecticide at eight dosages ranging from 0·4 to 5 mg. per sq. ft. DDT was equally effective at 0·2 mg. per sq. ft., but 16 per cent. of the larvae that received this dose of 666 were alive after 24 hours. All pupae were dead or moribund 24 hours after treatment with 1 mg. DDT or 666 per sq. ft. As moribund larvae would not recover, it is concluded that both DDT and 666 are excellent larvicides, giving complete control at very low dosages, and that there was no significant difference between them over the range of dosages tested. Larvae and pupae treated with DDT lost muscular co-ordination and were unable to rise to the surface sooner than those treated with 666. Acetone at the dosages applied had no significant larvicidal effect.

BLANC (G.) & BALTAZARD (M.). [**A Series of Papers on Typhus.**]—*Arch. Inst. Pasteur Maroc* **2** fasc. 4 pp. 535–715. Algiers, 1944.

This series comprises the following 11 papers, all of which are by Blanc & Baltazard only, with the exception indicated.

Revue chronologique sur la transmission et la conservation naturelles des typhus (pp. 535–577). This is a review of the literature published up to 1939.

Etude du comportement des virus exanthématiques chez divers ectoparasites: I. Comportement du virus du typhus murin chez le pou de l'âne, *Haematopinus asini*, by Blanc, L. A. Martin & Baltazard (pp. 578–585), **II. Comportement du virus du typhus épidémique chez les puces,** *Xenopsylla cheopis* **et** *Pulex irritans* (pp. 586–601) and **III. Comportement des virus de la fièvre boutonneuse et de la fièvre pourprée chez les puces** *Xenopsylla cheopis* **et** *Ctenocephalus canis* (pp. 602–610). The contents of the first and the greater part of the second of this group of papers have been noticed from briefer sources [*R.A.E.*, B **28** 129; **29** 15]. The second also contains accounts of experiments in which *Xenopsylla*

cheopis, Roths., failed to transmit epidemic typhus to guineapigs by biting when the possibility of contamination by excreta was excluded, and did so in only a proportion of cases and after prolonged exposure when it was not, whereas a rat exposed to fleas and contamination by their excreta, readily became infected. A rat infested with fleas spends much time licking its fur. In so doing, it ingests large numbers and also dilutes the excreta on the fur, thus facilitating penetration of the mucous membranes by the infecting agent, whereas an infested guineapig scratches superficially to dislodge fleas, but does not lick. Epidemic typhus was transmitted to monkeys (*Macaca sylvana*) by placing the dry excreta of infected fleas, which had been kept in the laboratory for 8–115 days, on the mucous membranes of the eyes, nose and lips. A few experiments, details of which are not given, showed that the behaviour of the causal agent of epidemic typhus in *Pulex irritans*, L., was the same as in *X. cheopis*.

The third paper deals with experiments carried out in 1938–40 on the behaviour of the agents of Marseilles fever and Rocky Mountain spotted fever in *X. cheopis* and *Ctenocephalides* (*Ctenocephalus*) *canis*, Curt. The agent of Marseilles fever survived for 44 days in examples of *X. cheopis* that had bitten infected rats, but they did not transmit the disease by biting and their excreta were not infective when injected intraperitoneally into guineapigs 0–15 days after collection. *C. canis* acquired the infection from guineapigs, but its excreta were not infective. Fleas of only one out of many batches of *X. cheopis* harboured the agent after being confined with infected guineapigs. *X. cheopis* has been found to bite guineapigs much less readily than rats, and biting experiments made on the former have therefore comparatively little significance.

When batches of crushed fleas (*X. cheopis*) that had completed a few meals 1–70 days previously on a guineapig ill with Rocky Mountain spotted fever were inoculated into guineapigs, fleas that had had their last infecting meal 3, 7 and 12 days previously induced infection but the others did not. The fleas did not transmit the disease by biting, and their excreta were not infective when injected intraperitoneally into guineapigs. Guineapigs did not become infected by injection of crushed fleas that were the offspring of those fleas. When the fleas had the opportunity of feeding on infected animals for a long time, the infection persisted in them throughout their life, but they did not transmit it by biting and their excreta were not infective.

Recherches sur l'immunité dans les maladies exanthématiques humaines : I. Immunité conférée par l'infection apparente (pp. 611–624). **II. Immunité conférée par l'infection " inapparente " ou l'infection " atténuée "** (pp. 625–632). **III. Qualité de l'immunité. Réinfection inapparente** (pp. 633–650). **IV. Immunité générale et immunité locale** (pp. 651–655). This group of papers deals with investigations made from 1933 to 1942 on immunity in human diseases of the typhus group, and earlier work on this subject is also reviewed It is demonstrated in the first that the immunity conferred by apparent infection with epidemic and murine typhus, Marseilles fever and Rocky Mountain spotted fever is complete and lasting, no reinfection ever having been observed by the authors, and that an equally strong cross immunity exists between Marseilles fever and Rocky Mountain spotted fever and between epidemic and murine typhus. In the second, it is demonstrated that inapparent infection with the four diseases in man and animals confers absolute immunity for several years, and in the third that inapparent reinfection is extremely rare. It was only once observed in the course of the 31 experiments described, which involved the four diseases and inoculation of 233 animals in attempts to recover the agent. This was inapparent infection with Rocky Mountain spotted fever in a guineapig that had had inapparent Marseilles fever 14½ months earlier.

Recherches sur le mode de transmission du typhus : I. Non-transmission du typhus exanthématique par piqûres de poux infectés (pp. 656–657). **II. Le**

réservoir de virus naturel des typhus, les déjections d'ectoparasites infectés (pp. 658–673). In the experiments described in the first of these two papers, lice [*Pediculus humanus*, L.] taken from two persons infected with epidemic typhus failed to infect eight Europeans on whom they fed through bolting silk under conditions that made contamination of the skin by louse excreta impossible. Each person was exposed for 15 minutes to about 140 lice (which were subsequently shown to be infected) and was later shown to be susceptible to murine typhus.

Data collected from 1937 to 1942 on the infectiveness of the excreta of ectoparasites infected with murine typhus are discussed in the second paper, largely from the point of view of the preparation of vaccines. Experiments are described showing that infected fleas emit uniformly infected excreta throughout life, irrespective of season or temperature, and the same is true of epidemic typhus [**29** 16]. Injection into guineapigs of less than 1 mmg. of excreta never caused infection, 1–10 mmg. gave apparent infection or none when injected intraperitoneally and inapparent infection or none when injected subcutaneously or intradermically, and higher doses almost always gave apparent infection after an incubation period of six days when injected intraperitoneally, and an immunising inapparent infection in all cases when injected subcutaneously or intradermically. In man, infection always followed intramuscular or subcutaneous injection of 10 mmg. [*cf.* **28** 128] and followed injection by the same routes of 1 mmg. in a high percentage of cases. The excreta did not lose infectiveness when stored for 4½ years; the agent of epidemic typhus also persisted for a considerable time in stored flea excreta, but the experiments were not continued for so long. The highest and lowest temperatures met with in nature and alternation of these temperatures did not affect persistence of the infective agent in excreta so long as they were kept protected from humidity. It was destroyed by exposure to ordinary daylight for 12 months but not for six, by an hour's exposure to 120°C. [248°F.] in a dry atmosphere or to 60–80°C. [140–176°F] in a damp atmosphere, or by fumigation with sulphur dioxide for 30–120 minutes, but was not affected by fumigation with methyl bromide, which is sometimes used against lice in clothing. Experiments on man showed that its normal mode of passage from the dry excreta into the vertebrate host is through the mucous membranes.

Transmission et conservation naturelles des typhus. Immunité. Epidémiologie. Prophylaxie (pp. 674–704). This paper forms a conclusion to the series and is a critical review of the literature. Epidemic typhus is not transmitted by the bites of infected lice. Natural infection of the vertebrate host with the typhus fevers occurs through penetration of the mucous membranes by the causal agents from the excreta of ectoparasites. These excreta are the reservoir. The agent can circulate in the blood of persons who have no symptoms and infect ectoparasites, thus increasing the intensity of an epidemic. As a man has been found to be susceptible to infection a comparatively short time after having the agent circulating in his blood, the hypothesis is put forward that, in addition to persons with inapparent infection, there are healthy carriers who do not acquire lasting immunity. The causal agents of murine and epidemic typhus are distinct entities, and each is a single type and does not comprise a number of different strains. If a louse-transmitted epidemic of murine typhus occurred, it could do so only where lice were abundant and epidemic typhus was therefore likely to occur also, and it would immunise much of the population. The basic measure for preventing the spread of epidemic typhus remains the control of *Pediculus humanus*, but disinfection should also be designed to destroy the agent in its excreta on the clothes or in the houses of infected persons. In view of the susceptibility of the agent to moisture, this is best done by washing in weak disinfectant for the house and furnishings and steam sterilisation for clothing and bedding.

Index bibliographique (pp. 705–715). This comprises 171 references.

PHILIP (M. I.), RAMAKRISHNA (V.) & VENKAT RAO (V.). **Turmeric and Vegetable Oils as Repellents against Anopheline Mosquitoes.**—*Indian med. Gaz.* **80** no. 7 pp. 343–344, 2 refs. Calcutta, 1945.

Data obtained in malaria surveys in the Jeypore Hill tracts in Orissa and North Vizagapatam and one in southern Madras [*R.A.E.*, B **27** 44] showed that the spleen indices were much higher for males than for females. In investigations in the Jeypore Hills on the feeding habits of Anophelines of the group of *Anopheles fluviatilis*, James, in houses at night, the mosquitos were observed to bite men only, though women were sleeping near them. To determine whether a repellent effect was exercised by the turmeric and gingili or mustard oil that most of the women apply to their bodies daily before taking a bath without soap, females of *A. fluviatilis*, collected in the Jeypore Hills, were given the opportunity of biting a hand that had been smeared with turmeric and mustard oil and then washed with plain water. They did not do so, but fed rapidly on the untreated hand, which was introduced into the cage immediately afterwards. The same result was obtained in an experiment with *A. subpictus*, Grassi, and *A. annularis*, Wulp, in northern Madras in which gingili oil was used instead of mustard oil.

JOSHI (K. G.) & DNYANSAGAR (V. R.). **Some Observations on Fly Breeding in Compost Trenches.**—*Indian med. Gaz.* **80** no. 7 pp. 358–361. Calcutta, 1945.

The old methods of disposing of refuse and excreta in towns in the Central Provinces and Berar by stacking the refuse in heaps and burying the excreta under 6–12 ins. of earth, allow of prolific breeding by flies and are wasteful of matter that is of potentially high value as manure. The making of compost, which is advocated as more sanitary and more economic, is sometimes thought not to prevent fly-breeding satisfactorily. Fly production in material composted by the Bangalore method at Amraoti was therefore investigated in 1944. Trenches measuring 20×6× 3 ft. were filled with alternate layers of 6 ins. of refuse and 2 ins. of excreta, with 9 ins. of refuse covered with 2 ins. of earth on top [*cf. R.A.E.*, B **35** 1]. There were very few larvae and pupae of flies in the top layer of refuse in April, May and June. The maximum temperature in the top layer at this season was 60–65°C. [140–149°F.], which was reached in the first week and maintained for over a fortnight. This is considered effective in killing larvae and pupae. On the other hand, the maximum temperature of the top layer during the rainy season was rarely much above 50°C. [122°F.] and often much less, because excessive moisture delayed decomposition. The refuse as well as the excreta arrived heavily infested, and larvae and pupae were very abundant. However, only 10–20 per cent. of the pupae taken from compost trenches in the monsoon season gave rise to adults under favourable conditions in small cages.

SUNDAR RAO (S.). **Filarial Infection in Dhamda (Drug District, C. P.) due to *Wuchereria malayi*.**—*Indian J. med. Res.* **33** no. 1 pp. 175–176, 3 refs. Calcutta, 1945.

As conditions in the village of Dhamda were reported to be similar to those in Ratanpur [*R.A.E.*, B **29** 86], which is in a different district of the Central Provinces, a filariasis survey was undertaken there in February 1942. Eighty people (2·2 per cent. of the population) had elephantiasis of the legs or hands and gave a history of lymphangitis recurring at varying intervals. Abscesses along the main lymphatic vessels were also common. Examination of blood taken from 120 disease-free persons between 9 p.m. and midnight showed microfilariae of *Filaria* (*Wuchereria*) *malayi* in 16 of them and no infection by *F.* (*W.*) *bancrofti*. *Mansonia* (*Mansonioides*) *annulifera*, Theo., *M.* (*M.*)

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uniformis, Theo., *Culex fatigans*, Wied., and *Anopheles culicifacies*, Giles, were prevalent during the survey. The first two bred in most of the large reservoirs, all of which were covered with *Pistia stratiotes*. *C. fatigans* bred in small collections of water near wells. Filarial infection was found only in *M. annulifera*, which was the commonest mosquito in the area.

JELLISON (W. L.). **The geographical Distribution of Rocky Mountain Spotted Fever and Nuttall's Cottontail in the western United States.**—*Publ. Hlth Rep.* **60** no. 33 pp. 958–961, 1 map, 6 refs. Washington, D.C., 1945.

A close geographical association is shown to exist between spotted fever in the western United States and *Sylvilagus nuttallii*. In the twelve States that comprise the main endemic area of the disease in the west, this rabbit is present in 55·88 per cent. of the counties, and 99·58 per cent. of the cases recorded at the Rocky Mountain Laboratory up to 1942 with a county of origin occurred within its range, as have the few reported Canadian cases, with one possible exception. Other species of *Sylvilagus* are present in all the other parts of the United States in which spotted fever has been recognised, and also in Brazil, Colombia and the Mexican State of Sinaloa, where a presumably identical disease occurs. *S. nuttallii* is an important host of the immature stages of *Dermacentor andersoni*, Stiles, the vector of spotted fever in the western States, and is one of the few mammals on which all stages feed. It has been found susceptible to spotted fever and occurs in great numbers within its range. It thus has the qualifications of a reservoir of spotted fever, though there is no definite record of the causal agent having been recovered in nature from this or any other mammal in the endemic area of the western United States [*cf. R.A.E.*, B **32** 45]. The distribution of *D. andersoni* practically coincides with that of *S. nuttallii*, and moreover, the ranges of *D. variabilis*, Say, the vector of spotted fever in the eastern States, *D. occidentalis*, Marx, and *D. parumapertus*, Neum., coincide with those of *S. floridanus*, *S. bachmani* and *Lepus californicus*, respectively, with the exception of one area on the Pacific coast where *D. variabilis* occurs and *S. floridanus* does not.

MACCREARY (D.). **Ticks of Delaware with special Reference to *Dermacentor variabilis* (Say) Vector of Rocky Mountain Spotted Fever.**—*Bull. Del. agric. Exp. Sta.* no. 252, 22 pp., 1 map, 1 graph, 9 refs. Newark, Del., 1945.

The following is based on the author's summary of the results of an investigation begun in January 1939. *Dermacentor variabilis*, Say, is distributed throughout Delaware, though certain areas maintain higher populations than others. It has increased in numbers, particularly in the north, since farmland has been abandoned and more protective cover has thus become available for the hosts of the immature stages. The hosts of the adults included man, cattle, horses, pigs, dogs and cats, and also the fox, woodchuck [*Marmota monax*], oppossum, skunk and grey squirrel. The dog and the fox were the most important. The time of appearance of the adult ticks in spring apparently depends on weather. There was a difference of about two weeks in the earliest observed infestation of dogs in 1940 and 1941, and the collections indicated that if the ticks appear early in spring, they reach their peak population early and their abundance later in the season is correspondingly reduced. The hosts of the immature stages are various rodents [*R.A.E.*, B **30** 2] of which the meadow mouse (*Microtus pennsylvanicus*), pine mouse (*Pitymys pinetorum pinetorum*) and white-footed mouse (*Peromyscus leucopus*) were the most important. The average number of ticks per infested animal on these hosts were 23·4, 6·9 and 4·8, respectively. Larvae and nymphs were taken in all months except January and February and were most plentiful in early

spring. From 1933 to 1944 inclusive, 49 cases of Rocky Mountain spotted fever, of which *D. variabilis* is the vector in the eastern States, were reported in Delaware, and nine of these were fatal. Nearly two-thirds of the cases occurred in June and July.

The other ticks that have been collected in Delaware are *Ixodes dentatus*, Marx, *I. cookei*, Pack., *I. marxi*, Banks, *Haemaphysalis leporis-palustris*, Pack., which is of considerable importance as it carries tularaemia and Rocky Mountain spotted fever among small mammals, *Rhipicephalus sanguineus*, Latr., which seems to have become well established on dogs since its introduction in 1939 [*loc. cit.*] though there is no evidence that it can overwinter out of doors, and one example each of *Amblyomma maculatum*, Koch, and *A. americanum*, L.

BEKKER (P. M.). **Tobacco Extract for Control of Arsenic-resistant Blue Tick and Cattle Lice.**—*Fmg in S. Afr.* **19** no. 225 pp. 775–780, 2 figs., 1 ref. Pretoria, 1944.

A strain of *Boophilus decoloratus*, Koch, first found in the East London area of Cape Province, cannot be effectively controlled by arsenical dips, even if the strength of the dip and frequency of treatment are increased, though it is apparently identical in all other respects with the ordinary form. It has spread along the coast northwards through Natal and for some distance southwards. Extensive experiments have shown that it can be controlled by the addition of 0·04 per cent. nicotine to the arsenical dip used every seven days, but as many as seven dippings may be necessary. The addition of 2 gals. kerosene to 100 gals. arsenical dip did not increase its effectiveness. Nicotine is usually sold as tobacco extract (nicotine sulphate containing 40 per cent. nicotine) and the quantities of 40 per cent. nicotine to be added when preparing various quantities of fresh dip are shown in a table. As there is no method of determining the nicotine content of a dip in the field, the amount of nicotine to be added subsequently is calculated as a proportion of the amount of sodium arsenite that is found to be necessary. A table is, however, given showing the quantities of nicotine to be added if a chemical analysis has shown the dip to be deficient in nicotine but not in arsenic. Directions are also given for diluting the dip if the nicotine content is too high. The nicotine had no more detrimental effect on the animals than the ordinary arsenical dip, if the same precautions were taken.

It is well known that the red biting louse of cattle [*Damalinia bovis*, L.] is killed by the ordinary arsenical dip, whereas sucking lice [Anoplura] are not, but the latter can be controlled by a single treatment with the dip containing 0·04 per cent. nicotine.

THEILER (G.). **Ticks in the South African Zoological Survey Collection. Part V. Three African Haemaphysalids parasitic on domestic Stock.**—*Onderstepoort J. vet. Sci.* **20** no. 2 pp. 191–207, 34 figs., 6 refs. Pretoria, 1945.

Descriptions are given of the larvae, nymphs and adults of both sexes of *Haemaphysalis aciculifer*, Warb., *H. parmata*, Neum., and *H. silacea*, Robinson, with records of their hosts and distribution. *H. silacea*, which occurs only in South Africa, is found mostly on cattle, but has also been collected on sheep and goats. Its range extends from the coast to the foothills of the mountains in Eastern Cape Province in areas in which the annual rainfall is between 12 and 25 ins. and the vegetation is the xerophytic thicket, mostly tall karroid scrub, known as the Fish River Bush. *H. parmata* has not been recorded from the Union. The occurrence of *H. aciculifer* on domestic stock in South Africa appears to be confined to more or less localised areas in the Northern and Eastern Transvaal, which have little in common as regards vegetation or climate. Its discontinuous distribution is attributed to the fact that it was

brought into the country on introduced cattle, probably about 50 years ago, and so did not reach all farms in a given area and could maintain itself only where conditions were favourable. Cold and frost seem to be the factors limiting its distribution.

Ewing (H. E.). **Note on Taxonomy of Type Species of the Mite Genus *Trombicula* Berlese.**—*U.S. nav. med. Bull.* **43** no. 4 pp. 837–839, 1 fig., 4 refs. Washington, D.C., 1944.

Berlese described *Trombicula minor* as the type of its genus in 1905 from two specimens found in cave guano in Java. Certain statements in his descriptions have led to the belief that the two specimens were nymphs and also that *T. hirsti*, Sambon, is a synonym of *T. minor* [*cf. R.A.E.*, B **28** 146]. Gunther, having reared several nymphs from larvae of his *Trombicula hirsti* var. *buloloensis*, taken in the Morobe District of New Guinea, concluded that they were the nymphs of *T. minor*. In this, he apparently followed Womersley [*cf.* **32** 161]. However, C. Willmann [as reported in a paper that has apparently not been received in this country (*Zool. Anz.* **133** (1941) pp. 131–136)], has found from re-examination of the type material of *T. minor* that the specimens were adults and had three subterminal spines on the palpal tibia (the correct number for adults) and not two as stated in Berlese's descriptions. Willmann's figures of the area sensilligera and the palpal tibia of *T. minor* and Gunther's of these parts of the reared nymphs of *T. hirsti* var. *buloloensis* are given for comparison, and it is concluded that *T. hirsti* is a species distinct from *T. minor*.

Rau (P.). **Food Preferences of the Cockroach, *Blatta orientalis* Linn.**—*Ent. News* **56** no. 10 pp. 276–278. Philadelphia, Pa. [?1946.]

In a test of the comparative attractiveness to *Blatta orientalis*, L., of seven kinds of foodstuff exposed for 11 days in new wire traps, it was found that starchy food was preferred almost to the exclusion of other types. Of 144 cockroaches that entered the traps, 65 were attracted to cinnamon bun, 44 to bread, 22 to cooked potato, 10 to banana, two to celery, one to boiled egg and none to bacon. Cockroaches first entered the traps containing the most favoured foods on the third night. Longer elapsed before any entered the other traps. It was shown that the presence of cockroaches in traps did not attract others to join them.

Fennah (R. G.). **Preliminary Tests with DDT against Insect Pests of Food-crops in the Lesser Antilles.**—*Trop. Agriculture* **22** no. 12 pp. 222–226. Trinidad, 1945.

This paper on trials of DDT made in St. Lucia [*cf. R.A.E.*, A **35** 92] includes data on the control of some Arthropods that affect man and animals. Treating all manure heaps at 200 mg. DDT per sq. ft. of surface and all the feeding troughs and hanging fixtures and the food-mixing compartment of a concrete dairy at 100 mg. per sq. ft. with a spray prepared with soft water from a stock emulsion of 40 gm. DDT, 70 ml. tetralin [tetrahydronaphthalene], 10 ml. Triton B-1956 [a phthalic glyceryl alkyd resin], 1 gm. soap and 145 ml. water gave complete control of flies within two hours. No effect was noticeable after two weeks, apparently because of the routine washing of the dairy and the disruption of the sprayed surface of the manure heaps by the scratching of hens. It was later found that complete treatment of exposed manure with protection of the sprayed cover was essential, but that spraying of dairy buildings could be limited to selected areas such as hanging fixtures, sides of windows and doors, sunlit areas of wall and floor in the food-mixing room, the mixing trough and sacks of feeding stuff. It was estimated that more than

75 per cent. of the flies in the dairy congregated in these positions when cattle were absent. When sprayed with emulsion containing 8 per cent. DDT to give slightly more than 300 mg. DDT per sq. ft., they remained lethal to flies for five weeks. Sprayed celluloid strips taken for cage tests after exposure for this period were toxic to flies for a further four weeks, the mortality of field-caught flies during a period of 24 hours being 73 per cent. in a cage with sprayed celluloid on the floor, 18 per cent. in one containing celluloid covered with residues of emulsion devoid of DDT and 22 per cent. in one with unsprayed celluloid.

A dust of 10 per cent. DDT in talc applied to a dog infested by ticks caused the nymphs to leave it and die within 3–4 days, but did not affect the adult females, and the latter lived for 6–15 days when caged in the presence of pure DDT dust at about 300 mg. per sq. ft. Four scorpions exposed in a cage of which the floor had been dusted with 10 per cent. DDT at about 300 mg. per sq. ft. spent most of their time on the floor and died after 3–5 days, but two large Avicullariid spiders similarly exposed remained for much of the time in the upper corner of the cage and lived for 9 and 13 days, respectively.

When applied as a contact spray in buildings, the emulsion diluted to contain 3 per cent. DDT immediately incapacitated cockroaches, mosquitos and sand-flies [*Culicoides*]. The sandflies were killed at once and the mosquitos also if thoroughly wetted. Some flies were knocked down and others driven from the sprayed zone. Cage observations on samples of the latter showed that 73 per cent. died within 1–6 hours.

The DDT emulsion diluted to contain 2 per cent. DDT produced no ill effects when sprayed on dogs and livestock, and 15 monthly applications to dogs of pure sifted DDT dust at the rate of one gm. per sq. ft. also caused no ill effects. No effects of any kind were noticed when the author inhaled 100 mg. of sifted pure DDT daily for 13 months, with a break of a fortnight, and drank water dusted with pure DDT at more than 300 mg. per sq. ft. daily for the same period with a break of a month, or later when all the food he took over a period of a month was sprayed, following preparation, with 3 per cent. DDT emulsion to give a deposit of 100 mg. per sq. ft., or when his arms and hands were swabbed at intervals of about 15 days with 5 per cent. DDT emulsion, which was allowed to dry to give a deposit of 200 mg. per sq. ft.

WILSON (G. F.). **D.D.T. : Investigations on its Effect upon some horticultural Pests.**—*J. R. hort. Soc.* **71** pt. 1 pp. 6–13. London, 1946.

This account of investigations in southern England in 1944–45 on the toxicity of DDT to various garden pests includes the results of tests of its effectiveness against mosquitos, mosquito larvae and three kinds of household pests. The dust used contained 5 per cent. DDT and the sprays were proprietary emulsions diluted to contain 1 and 0·1 per cent. DDT. The dust was completely effective against *Blatta orientalis*, L., in a canteen kitchen within three days and against adults of *Ctenocephalides canis*, Curt., in a dwelling house. The 1 per cent. spray killed all flies (*Musca domestica*, L.) within 12 hours when applied in rooms in dwellings, but reinfestation occurred. Kill was slow, but the paralytic effect was increased by the addition of pyrethrins. There was little lasting effect on flies alighting on the film that remained on the walls. Many hundreds of adults of *Culex pipiens*, L., overwintering on the walls of an underground stokehole and of a dark room were killed by applying the 0·1 per cent. spray to the walls.

Tests with the emulsions applied at various dosages against larvae of *C. pipiens*, *Culiseta* (*Culicella*) *morsitans*, Theo., and *C.* (*Theobaldia*) *annulata*, Schr., in ornamental ponds, woodland pools, water-storage tanks and ditches confirmed that the standard dosage of 1–2 qt. per acre (0·2–0·4 cc. per sq. yd.) of a 5 per cent. solution of DDT in a suitable oil of good spreading power

[*R.A.E.*, B **34** 154] was effective against the three species. Far lower dosages were effective in the laboratory, but it would be difficult to apply them with the apparatus available in gardens. On open ponds, a compressed-air knapsack sprayer was used under low pressure with a fine nozzle.

JONES (H. A.), FLUNO (H. J.) & MCCOLLOUGH (G. T.). **Solvents for DDT.**—*Soap & sanit. Chem.* **21** no. 11 pp. 110–113, 115, 155, 1 graph, 3 refs. New York, N.Y., 1945.

Extensive investigations have been carried out in Florida on the solubility of DDT in a wide range of solvents suitable for use in preparations for the control of insects affecting man. Solubility was determined by a simple synthetic method and a refractive index method, both of which are described. Most solvents were tested by both methods.

The results are set out in a table giving the solubility of DDT in gm. per 100 ml. and per 100 gm. of each solvent at 27–30°C. It shows that several ketones (acetophenone, cyclohexanone, methyl isobutyl ketone, isophorone and mesityl oxide) have high solvent power for DDT, as also have the aromatic hydrocarbons (benzene, xylene, etc.), the chlorinated aliphatics (methylene chloride, trichlorethylene, etc.), the chlorinated aromatics (chlorbenzene, orthodichlorbenzene etc.) and some ethers (dioxane, anisole, etc). Several esters (ethyl benzoate, tributyl phosphate, etc.) and the one lactone tested (γ-valerolactone) are good or moderately good solvents. The aliphatic petroleum fractions are comparatively poor, but have the advantage of being readily available in many areas. Some, such as crude kerosene and fuel oil, are variable in composition, and the solubility of DDT in them may be expected to vary with different samples. Aromatic petroleum fractions generally dissolve rather large proportions of DDT, and many of them are being used as auxiliary solvents. DDT is generally very soluble in aromatic fractions obtained from coal tar, but is not highly so in cresylic acid. With one or two exceptions, pine-distillation products tested are only moderately good solvents. Among many miscellaneous products tested, Aroclor 1242 (a chlorinated diphenyl) was a good solvent. The vegetable oils tested are about as good as the aliphatic petroleum products.

A table is given showing the density, boiling point or range and flash point of some of the solvents that may be most useful, principally in preparing solutions and emulsions, for the control of insects affecting man, together with the solubility of DDT in them in pounds per U.S. gallon. They may be useful alone or as auxiliary solvents. They are chosen with regard to various considerations, including availability, cost and possible toxicity to man. Chlorinated solvents, which may be too toxic for use in confined spaces, are included for comparative purposes. The possible usefulness of some of the solvents is briefly discussed.

GERSDORFF (W. A.) & MCGOVRAN (E. R.). **Insecticide Toxicity Studies. Experimental Results on the comparative Toxicity of Benzene Hexachloride, DDT and Pyrethrum.**—*Soap & sanit. Chem.* **21** no. 11 pp. 117, 121, 1 fig., 1 ref. New York, N.Y., 1945.

Pure samples of the γ isomer of benzene hexachloride (1, 2, 3, 4, 5, 6 hexachlorcyclohexane) [*cf. R.A.E.*, B **33** 130] and of the p,p′ isomer of DDT (1-trichlor-2,2-bis(p-chlorphenyl)ethane) and a purified pyrethrum concentrate were used in turntable tests [*cf.* **26** 246] of the comparative effectiveness of the three materials against *Musca domestica*, L. Refined kerosene was the solvent in all sprays. The mean concentrations of benzene hexachloride, DDT and pyrethrins calculated to give 50 per cent. mortality were 0·0888, 0·788 and 1·61 mg. per ml. The rates of increase of toxic action with increase in

concentration differed in the three substances. The difference between benzene hexachloride and DDT was not great but that between them and pyrethrins was considerably greater. The highest concentrations of benzene hexachloride, DDT and pyrethrins for which results are given are 0·25, 2 and 4·4 mg. per ml., respectively. These gave 44, 40 and 100 per cent. knockdown in 25 minutes and 94, 96 and 86 per cent. mortality after one day.

Bushland (R. C.), Schechter (M. S.), Jones (H. A.) & Knipling (E. F.). **Antioxidants for Pyrethrum Powders.**—*Soap & sanit. Chem.* **21** no. 11 pp. 119, 121, 5 refs. New York, N.Y., 1945.

An account is given of the experiments on the value of various antioxidants (including anti-polymerisation agents) for pyrethrins in powders for the control of *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) on man, as a result of which Phenol S (isopropyl cresols) was chosen for incorporation in a powder for use by the United States forces [*R.A.E.*, B **34** 45]. Hydroquinone was the best antioxidant tested, but was not chosen, as it caused a definite skin reaction. Phenol S at 3·3 per cent. proved harmless and prevented detectable deterioration for 79 days, but the dust containing it had lost its toxicity to lice after a year. In a second series of tests in which dusts containing 0·5 per cent. antioxidants were exposed for a year, results were generally better when the diluent was pyrophyllite than when it was talc or kaolin.

Wisecup (C. B.) & Shillinger (W. D.). **Observations on the Abatement of Pest Mosquitoes with DDT residual Sprays.**—*Florida Ent.* **28** no. 2 pp. 27–29, 2 refs. Gainesville, Fla., 1945.

Mosquitos of the genus *Psorophora* became extremely abundant and troublesome near the Army Air Field at Stuttgart, Arkansas, in the summer of 1944 owing to the alternate drying and reflooding of the surrounding rice-fields. An emulsion containing 10 per cent. DDT, prepared from a concentrate consisting of 25 per cent. DDT, 7 per cent. Triton X-100 (an aralkyl polyether alcohol) and 68 per cent. xylene, was applied in July to the screens on all entrances and windows of the hospital building and the entranceway and interior walls of a large latrine and bath-house. A remarkable decrease in mosquito populations in the building was apparent by the next morning, and no further treatments were necessary in it, despite the continued abundance of mosquitos in the area. The bath-house was completely free of mosquitos for two weeks, after which the conspicuous residue was washed off by order of an inspector who did not appreciate its object. A heavy application of the emulsion to the exterior walls of a house and the surrounding garden freed this limited area of mosquitos for at least ten days without apparent injury to the vegetation. Application of a 5 per cent. solution of DDT in kerosene with a power paint sprayer to half of one block of buildings and of a 5 per cent. emulsion to half of another block greatly reduced the abundance of mosquitos in daytime as compared with the untreated halves. All entranceways were sprayed and also the foundations and walls to a height of 6 ft. and vegetation to a distance of 6 ft. from the buildings. Deposits were slightly over 130 mg. DDT per sq. ft. Mosquito activity at night as recorded by catches in light-traps was the same in treated and untreated areas.

Wright (M.). **Dragonflies predaceous on the Stablefly** *Stomoxys calcitrans* **(L.).**—*Florida Ent.* **28** no. 2 pp. 31–32, 2 refs. Gainesville, Fla., 1945.

In this continuation of a paper of which the first part has been noticed [*R.A.E.*, B **34** 190], observations are recorded demonstrating that the dragonflies seen on beaches in Florida were actually feeding on *Stomoxys calcitrans*, L.

They seized the flies while these were swarming about livestock, flying away after feeding on the observer, swarming in open areas or resting on the walls of buildings, and they usually consumed them during flight. Several dragonflies were caught with recognisable remains of *S. calcitrans* in their mouth-parts. Few other species of insects were present during the periods when *S. calcitrans* was abundant. Data are given indicating the extremely large numbers of dragonflies involved.

Neal (P. A.) & others. **Toxicity and potential Dangers of Aerosols, Mists, and Dusting Powders containing DDT.**—*Publ. Hlth Rep.* Suppl. no. 177, 32 pp., 8 figs., 25 refs. Washington, D.C., 1944.

Neal (P. A.), von Oettingen (W. F.), Dunn (R. C.) & Sharpless (N. E.). **Toxicity and potential Dangers of Aerosols and Residues from such Aerosols containing three per cent. DDT (Second Report).**—*Op. cit.* no. 183, 32 pp., 7 figs., 4 refs. 1945.

The first paper contains details of experiments made on laboratory animals and man, a shorter account of which has already been noticed [*R.A.E.*, B **34** 34], and the second deals with further experiments, the results of which confirm the conclusions drawn.

Dipping Screens with 5 per cent. DDT.—*Bull. U.S. Army med. Dep.* **4** no. 4 pp. 402–403. Washington, D.C., 1945.

An account is given of the procedure used at a large camp in the United States for dipping the window screens of more than 100 mess buildings in 5 per cent. DDT in a mobile tank mounted behind a lorry. The screens, which were removed in advance and piled near the garbage rack outside the building, were dipped by two men wearing rubber gloves and aprons and carried to and from the tank by two others. They were usually allowed to dry overnight before being replaced. About 1 U.S. pint solution per screen was needed. While dipping was in progress, the two remaining members of the team sprayed screen doors, the garbage-rack area and outside areas near the kitchen door. The whole camp, which had more than 100 mess buildings, was treated in May and again in July, the operation requiring less than a week. Control of flies was excellent. It was not necessary to spray the interior of the mess buildings ; hanging strips of fabric treated with DDT controlled the few flies that entered.

Berkowitz (S.). **Caterpillar Dermatitis.**—*Bull. U.S. Army med. Dep.* **4** no. 4 pp. 464–467, 3 refs. Washington, D.C., 1945.

A description is given of a skin eruption observed in New Guinea, where it sometimes reached epidemic proportions, and subsequently in northern Australia and found to have been caused by the hairs of Lepidopterous larvae. It was acquired by using a towel or putting on clothing over which the caterpillars had crawled and on which they had deposited hairs. The original wheals disappeared after 3–6 hours and were often followed by pruritic papules surrounded by diffuse erythema that lasted 10–14 days. The species responsible in Australia was *Ochrogaster contraria*, Wlk. [*cf. R.A.E.*, B **25** 247], and, in experiments with this Notodontid, the condition developed in all cases when larvae were allowed to crawl on the arm for ten minutes or when the cocoon or the tuft of anal hairs from the female moth was rubbed on the skin. From the universal occurrence of the reaction and later experiments, it was concluded that it is brought about by the injection of some irritating substance, by means of the insect's barbed hairs. No reaction occurred when the larvae crawled over the palm or the hairiest part of the forearm, presumably because the thick corneous layer of skin or the absence of follicular openings on the palm

prevented penetration by the barbs and because the hair on the forearm kept the caterpillar from touching the skin. Reactions were severest where the skin was thinnest. Intense itching occurred within 30 seconds of putting on a shirt on the inside of which a caterpillar had previously been allowed to crawl, and wheals appeared within five minutes. A similar but milder reaction occurred when the shirt was put on again ten days later. After laundering, the shirt caused no further reaction. Extract of the heads of the caterpillars, which are devoid of hairs, and of the skin together with hairs caused no reaction on unbroken skin but produced a typical reaction on scarified skin. A dead caterpillar kept in contact with the skin for 24 hours caused a typical reaction. Further studies indicated that no secretion or excrement of the caterpillar coming in contact with the skin is responsible for the eruption.

The hairs from the anal tuft of the female lost their nettling properties when crushed, but not when baked or soaked in saline, alcohol, acetone or 1 per cent. potassium hydroxide.

Sutton jr. (R. L.). **Pediculosis pubis : Treatment with DDT in Cold Cream.**—*Bull. U.S. Army med. Dep.* **4** no. 4 p. 480. Washington, D.C., 1945.

An ointment made by incorporating 1 part of a powder containing 10 per cent. DDT in 20 parts of a cold cream composed of 4·5 parts sodium borate, 70·5 parts white wax, 310 parts mineral oil and 115 parts water to give a final DDT content of 0·5 per cent. is recommended for the control of infestation by *Phthirus pubis*, L. A thin layer of the ointment is rubbed over all hairy parts of the body and legs, and a bath with soap is taken 12 hours later. Irritation stops and the mites die within 30 minutes, and eggs do not hatch. The ointment is not irritant.

Twinn (C. R.) & Balch (R. E.). **Insect Control in Lumber Camps with DDT.**—*Process. Publ. Div. Ent. Dep. Agric. Can.* no. 38, 8 pp. Ottawa, Ont., 1946. **How to use DDT in Lumber Camps.**—*Op. cit.* no. 39, 3 pp.

In the first paper, notes are given on the precautions necessary when DDT is used as an insecticide and the forms in which it is applied (oil solutions, emulsions, aerosols, dusts and water suspensions). These are followed by brief outlines of the life-history and control with DDT of the principal pests infesting lumber camps in Canada. These, of which only the popular names are given, comprise *Cimex lectularius*, L., *Pediculus humanus humanus*, L., *P. h. capitis*, Deg., *Phthirus pubis*, L., fleas, principally *Ctenocephalides canis*, Curt., and *C. felis*, Bch., cockroaches, flies, especially *Musca domestica*, L., and *Stomoxys calcitrans*, L., and mosquitos. The second paper contains similar information in a briefer form.

Nuñez Andrade (R.). **Dermatitis causada por *Haematosiphon inodora* (Dugès, 1892).**—*Medicina* **26** no. 501 pp. 45–51, 4 figs., 9 refs. Mexico, D.F., 1946. (With a Summary in English.)

Reports are given on 21 cases of dermatitis caused by bites of *Haematosiphon inodorus*, Dugès, in inhabitants of Mexico City in the summer of 1945. The dermatitis was polymorphic and caused intense irritation, a burning sensation and pain and sometimes general malaise and a rise of temperature attributable to secondary infections. All the inhabitants of infested houses were affected and almost all the houses in the quarter concerned were involved, the infestation having apparently spread from a house in which many fowls had been kept a short time before.

STEINHAUS (E. A.) **Insect Microbiology. An Account of the Microbes associated with Insects and Ticks with special Reference to the biologic Relationships involved.**—9½×6 ins., x+763 pp., 250 figs., 89 pp. refs. Ithaca, N.Y., Comstock Publ. Co. Inc.; London, Constable & Co., Ltd., 1946. Price $7.75 or 45*s*.

The author here co-ordinates information, which was previously available only in a widely scattered and often inaccessible literature, on the various relationships and associations that exist between micro-organisms (including viruses) and insects, ticks and mites. They are considered under the headings of extracellular bacteria, specific bacteria associated with Arthropods, intracellular bacterium-like and rickettsia-like symbiotes, rickettsiae, yeasts, fungi, viruses, spirochaetes, Protozoa associated with termites and Protozoa associated with other insects, and the relationships discussed include those in which the Arthropods transmit agents pathogenic to man, other animals and plants, those in which they are themselves attacked by pathogenic agents, and those in which the association is harmless or beneficial to them. One chapter deals with immunity in insects and the factors conferring it, and methods and techniques for rearing and studying insects, ticks and the various micro-organisms in the laboratory are given in another.

AKALIN (M. S.). **Anofeles makülipenis varyete Şingaref ve Anadolu makülipenisleri cihazı tenasülilerinde görülen anomaliler.** [*Anopheles maculipennis* Variety Shingarev and Anomalies in the Genitalia of *A. maculipennis* in Anatolia.]—*Türk. Z. Hyg.* **2** no. 2 pp. 16–29, 29 figs. Ankara, 1941. (With a Summary in German.)

In this lecture, the author briefly reviews the distribution of *Anopheles maculipennis*, Mg., and its importance as a vector of malaria, and refers to the work in Holland and elsewhere that has led to the recognition of varieties of this Anopheline that can be distinguished morphologically by the eggs and male genitalia and by differences in habits. He gives a general description of the genitalia of mosquitos of the genus *Anopheles* and of those of *A. maculipennis*, and points out that in 1928 Shingarev proposed the name *A. alexandrae-schingarevi* [*R.A.E.*, B **16** 200] for a form that differed from the typical *A. maculipennis* in having three spines on the side-pieces. Of 1,600 males of *A. maculipennis* taken in Anatolia, 95·8 per cent. had two spines on each side-piece, which is typical of the species, while the others had one and two, two and three, three and three, or three and four. There is thus no reason for considering *A. alexandrae-schingarevi* as a distinct form [*cf.* **26** 173]. Eggs with coloration characteristic of vars. *typicus* and *messeae*, Flni., were found in various parts of Anatolia, but there were also numerous intermediate types. The frequency of the different types varied somewhat with season, but not apparently with the salt content of the water, and quite dissimilar eggs were sometimes laid by the same female. Of 680 females examined, the palps of 89·7 per cent. were as long as the proboscis, which is usual, but they were shorter in 5·6 per cent. and longer in the rest. There were also differences in the length of the wings (3·3–6 mm.) and in venation. The number of hairs on the claspettes of 748 males was usually three, sometimes two, more rarely four and occasionally (though on one side only) five, and the proportion that were blunt or pointed also varied; 30 recognised variations are shown in a table. Some examples from the district of Smyrna bore a tuft of hairs on the ninth abdominal segment, which has not been previously described.

It is concluded that *A. maculipennis* shows a high degree of variation and that there are numerous intermediate forms between the recognised varieties.

Akalin (M. S.). **Anadolu flebotomlari.** [The *Phlebotomus* of Anatolia.]—*Türk. Z. Hyg.* **2** no. 2 pp. 113–127, 4 figs. Ankara, 1941. (With a Summary in German.)

In this lecture to medical students, the author gives a general account of the systematic position, morphology and bionomics of *Phlebotomus*. Of 1,624 males taken since 1928 in various parts of Anatolia and in Istanbul, 79·6 per cent. were *P. papatasii*, Scop., 9·3 per cent. *P. perniciosus*, Newst., 8·3 per cent. *P. minutus*, Rond. [possibly *P. theodori*, Parr. (*cf. R.A.E.*, B **31** 245)], and 2·6 per cent. *P. sergenti*, Parr. The local frequency of these species in several of the chief towns is given, and their male genitalia are briefly described.

Geigy (R.). **Malaria in der Schweiz.** [Malaria in Switzerland.]—*Acta trop.* **2** no. 1 pp. 1–16, 11 figs., 17 refs. Basle, 1945. (With Summaries in French and English.) **Sporogonie de** *Plasmodium vivax* **chez les anophèles de provenance suisse.**—*Rev. suisse Zool.* **52** fasc. 3 pp. 339-342, 1 ref. Geneva, 1945.

The second paper contains a briefer account of the experiments described in the first, of which the following is substantially the author's summary. Admission into a hospital at Basle in 1944 of a group of internees suffering from malaria caused by *Plasmodium vivax* enabled the author to make experiments on the possibility of infecting Swiss Anophelines with malaria parasites. The results showed that *Anopheles maculipennis*, Mg., var. *typicus* and *A. claviger*, Mg. (*bifurcatus*, auct.) collected from parts of Switzerland in which malaria formerly existed had not become immune but could develop typical gut and gland infections. However, the reappearance of indigenous malaria in Switzerland is considered improbable as it would require the simultaneous presence of numerous gametocyte carriers and Anophelines and high temperatures, the occurrence of which is unlikely.

Gaschen (H.). **Sur un cas d'invasion massive de vers de case.**—*Acta trop.* **2** no. 1 pp. 76–78, 2 figs., 4 refs. Basle, 1945.

Auchmeromyia luteola, F., which is widely distributed in Africa south of 18°N. lat., is closely associated with man. The adults feed on sweet liquids and faecal matter, avoid heat and sunlight and rest during the hottest part of the day in cracks in the walls of native huts. Each female usually lays two series of 30–90 eggs, which are deposited singly in the loose sandy soil that forms the floor of native huts and hatch in about 40 hours. The larvae are attracted to man by the warmth of the body and feed on blood, which they obtain by scraping the skin while adhering to it by suction. After feeding, they burrow into the soil to a depth of 1½–2 ins. A heavy infestation experienced by soldiers living in huts at Waghadugu in the Ivory Coast was immediately and completely controlled by digging the soil of the huts to a depth of 2–4 ins., wetting it thoroughly with a coal-tar disinfectant and ramming it firmly down. Infestation can be prevented by the use of raised beds.

Gaschen (H.). **Phlébotomes de Suisse.**—*Acta trop.* **2** no. 2 pp. 137–154, 8 figs., 15 refs. Basle, 1945. (With Summaries in English and German.)

Descriptions are given of both sexes of *Phlebotomus perniciosus*, Newst., and a male of *P. minutus* var. *parroti*, Adl. & Thdr., which were taken in a collection of *Phlebotomus* made at Ascona, Ticino, in the summer of 1944. The only species of the genus previously known to occur in Switzerland was *P. papatasii*, Scop., which was found in Vaud in 1912 [*cf.* also *R.A.E.*, B **19** 64].

Bouvier (G.) & Gaschen (H.). **Sur quelques parasites de diptères piqueurs.**—*Mitt. schweiz. ent. Ges.* **19** pt. 6 pp. 191–197, 14 figs., 6 refs. Berne, 1944.

The bulk of this paper deals with the observation in various parts of Switzerland of the infestation of Tabanids by Trombidiid larvae, which did not apparently harm them, but it is also recorded that adults of *Stomoxys calcitrans*, L., emerging from guineapig litter were heavily infested by *Eulaelaps stabularis*, Koch, which is normally a parasite of rodents and other mammals. There were up to 35 mites on individual flies, and they were firmly attached by their mouth-parts and engorged with haemolymph. It appeared that the parasitism caused intense hunger in the flies as they attacked man freely and ignored attempts to disturb them.

Torres Cañamares (F.). **Contribución al conocimiento del *Anopheles claviger* Mg. de España (Dip. Cul.).** [Contribution to Knowledge on *A. claviger* in Spain.]—*Eos* **20** pt. 3–4 pp. 233–245, 6 figs., 9 refs. Madrid, 1945.

Anopheline larvae found by the author in three localities of the Province of Cuenca, Spain, since November 1942 differed from typical larvae of *Anopheles claviger*, Mg., in the cephalic hairs and the palmate hairs of the abdominal segments. They gave rise to pupae and adults that appear identical with *A. claviger*, and a few typical larvae and intermediate forms were found in the same breeding places. They are thought to represent a variety of *A. claviger* and are described as var. *pollutus*, n. A table is given of the characters distinguishing them from larvae typical of *A. claviger* as found in other parts of Spain, notably Cordova, and as described by various authors. They were collected in autumn, winter and spring in three seasons and in very different habitats, but in all cases in dirty water. One was found in January in a very small quantity of almost freezing water under a thick layer of ice and gave rise to an adult in the laboratory. The larvae were abundant in March in pools at the same place, which was at an altitude of 3,330 ft. in cattle pasture, but had become scarce in April. In the second locality, the larvae were found on three occasions in a small weedy stream, once with a layer of ice over them and once when the temperature of the water was 18°C. [64·4°F.]. In the third, they were in pits containing seepage water at 18°C. heavily contaminated with organic matter. The typical larvae in Cordova were abundant in clean cold spring water in September and October and were also taken in streams and in a well.

Rearing experiments indicated that the larvae remain for a long period in the fourth instar during the autumn, winter or spring, even if the water is fairly warm, and that the pupal stage is completed in a few days. Adults in nature appeared in spring but were more easily found in September or October. They were taken in the open and never contained blood. As this Anopheline is very rare in areas where malaria is highly endemic and the females are rural in habit, are not active at the malaria season and apparently do not need a blood-meal to mature their eggs [*cf. R.A.E.*, B **31** 155], it is thought that they are not of importance as vectors of malaria.

Collignon (E.). **La campagne antipaludique de 1944 dans le département d'Alger.**—*Arch. Inst. Pasteur Algérie* **23** no. 2 pp. 98–110, 1 ref. Algiers, 1945.

Climatic conditions limited the extent of breeding places and consequently the Anopheline population in the department of Algiers in 1944, and this, combined with extensive anti-larval measures, designed principally to protect troops, and a fall in the number of gametocyte carriers, again kept the incidence of malaria relatively low with no marked epidemic [*cf. R.A.E.*, B **33** 195]. The number of gametocyte carriers among the indigenous population nevertheless remained considerable, and general distribution of prophylactic drugs was

not possible owing to shortage of supplies. Larvae of *Anopheles maculipennis*, Mg., were found, as usual, both in the plain and in the mountains. On 11th August, there were no larvae in the breeding places from which *A. claviger*, Mg. (*bifurcatus*, auct.) and *A. marteri*, Sen. & Prun., were recorded in 1943 [*loc. cit.*] and which had since been exposed to the light by the cutting of the dense thicket of the ravine.

SAUTET (J.). **Quelques détails sur l'anophélisme au Soudan français.**—*Méd. trop.* **2** no. 1 pp. 21–27, 1 map, 6 refs. Marseilles, 1942.

SAUTET (J.) & MARNEFFE (H.). **Notes sur le paludisme, la bilharziose intestinale, les teignes, etc. au Soudan français.**—*Op. cit.* **3** no. 5 pp. 343–367, 8 pls., 1 map, 2 figs., 4 fldg. tables, 25 refs. 1943.

In the first paper a list is given of the species of *Anopheles* in the French Sudan, which comprise those already noticed [*R.A.E.*, B **28** 13] and *A. nili*, Theo., with brief notes on their local distribution and the breeding places of the principal ones. In rearing experiments with *A. gambiae*, Giles, after it had been taken to Marseilles [*cf.* **28** 165], the larval and pupal periods lasted at least ten and two days, respectively, and pairing occurred readily in cages measuring 16×20×16 ins. when the adults were well fed. The females fed much more readily on man than on a guineapig, and many blood-meals were necessary for the maturation of eggs.

The second paper, which contains the results of observations made in September and October 1942, includes a comprehensive account of malaria in the French Sudan. Data are given on spleen and parasite rates and on the local distribution and habits of the Anophelines, with keys and tables for the identification of the adults of both sexes and larvae of the seven species. Adults of all were found in native huts and those of *A. gambiae* resting out-of-doors also [*cf.* **33** 63]. Precipitin tests showed that 55 per cent. of females of *A. gambiae* had fed on man [**33** 63]. An examination of eggs of this species from different parts of the Colony failed to reveal any racial difference. The breeding places of *A. gambiae* and *A. pharoensis*, Theo., the only species of which larvae were found, were similar to those in which they occur in neighbouring countries. The absence of larvae from water that seemed suitable for breeding was apparently due to the presence of larvivorous fish ; those identified belonged to the genus *Alestes*.

From further study of the form of *Ornithodoros erraticus*, Lucas, found in the French Sudan [**33** 100], it is considered by Sautet & M. Witkowski to represent a distinct variety, var. *sonrai*, n., the principal characters of which are given in tables. The egg stage of this tick lasted about 10 days. The larvae moulted five days after feeding, and the nymphs 4–5 times, 5–8 days after feeding. Females laid 80–100 eggs.

HUNDERTMARK (A.). **Versuche und Beobachtungen über das Verhalten von *Anopheles maculipennis* bei verschiedener Luftfeuchtigkeit und Temperatur.** [Tests and Observations of the Behaviour of *A. maculipennis* at different Humidities and Temperatures.]—*Z. angew. Ent.* **27** pt. 4 pp. 667–696, 7 figs., 16 refs. Berlin, 1941.

In the investigations described, which were carried out near Wilhelmshaven in 1939–40, the reactions to temperature and humidity of *Anopheles maculipennis*, Mg., vars. *atroparvus*, van Thiel, and *messeae*, Flni., which are indigenous to that district, were compared, and the humidities preferred by laboratory strains of *A. m. typicus*, *A. m. labranchiae*, Flni., *A. superpictus*, Grassi, and *Culex fatigans*, Wied., were also studied. The reaction to relative humidity of unfed females of the Anophelines up to 24 hours old was tested at 20°C. [68°F.] by means of flight chambers [*cf. R.A.E.*, B **26** 215], each offering two different relative humidities. Counts made at intervals of 24 hours

showed that *A. m. atroparvus* preferred 97 to 99 or 95 per cent. humidity, and 89–87 to 94 and 81 per cent., after the first day, and decidedly preferred 97 per cent. after the second. *A. m. messeae* preferred 97 per cent. to higher or lower humidities after both 24 and 48 hours. *A. m. typicus* showed little preference between 97 and 87 per cent. after 24 hours, but preferred 97 per cent. after 48. *A. m. labranchiae* preferred 95–94 per cent. after one day and 97 per cent. after two, while *A. superpictus* preferred 81 per cent. at first, but showed an increasing preference for higher humidity until it preferred 89–94 per cent. on the fourth day. Both summer and winter females of *A. m. atroparvus* showed a decided preference for 89 per cent. humidity on the first day after a blood-meal, but preferred 94–95 per cent. after three or more days, when the meal was digested, as also did unfed overwintering females. Both winter and summer females of *A. m. messeae* preferred about 97 per cent. In further tests at temperatures between 17 and 26°C. [62·6° and 78·8°F.], no difference in the preferred humidity of either variety was observed that could be attributed to temperature.

These results were confirmed by observations in summer in natural shelters. The relative humidity of a pig-sty in which females of *A. m. atroparvus* were abundant was found to be between 80 and a little under 100 per cent. Young and old females and young males of *A. m. messeae* were found in wet weather in a hollow tree in which the relative humidity was between 90 and a little less than 100 per cent., and adults were also abundant on the verandah of a dwelling where the humidity was between 80 and a little under 100 per cent. The relative humidity of places in which either variety hibernated [*cf.* **27** 50] was also within this range.

The reactions of *A. m. atroparvus* and *A. m. messeae* to temperature were also tested by means of flight chambers. Overwintering females preferred 15°C. [59°F.] to 20°C. and 20° to 23°C. [73·4°F.], but when a salt solution that gives a relative humidity of 98 per cent. was introduced, they preferred the higher temperatures. This was probably the result of air currents set up by the difference in temperature, which produced a saturated atmosphere in the cooler chamber, as such an atmosphere is avoided by these Anophelines. No difference was observed in the reactions of winter and summer adults, and it was evident from all the tests that humidity and not temperature was the decisive factor, though temperatures above 27–30°C. [80·6–86°F.] were avoided. In the field in summer, adults were found in a pig-sty at temperatures that ranged from 15 to 25°C. [77°F.] provided that the relative humidity was over 80 per cent., but a temperature of 21–22°C. [69·8–71·6°F.] was avoided when the humidity became too low. Overwintering adults of *A. m. messeae* were found in stable lofts at temperatures varying between —20°C. [—4°F.] and 25°C., on hay, straw or other hygroscopic substances that were poor conductors of heat. Females of *A. m. atroparvus*, which normally hibernate in cattle-stalls and suck blood throughout the winter though they do not mature eggs, also migrated to lofts when the temperature fell and humidity became too great in the stalls.

The results obtained by previous workers in tests of the temperature and humidity preferences of *A. maculipennis* [*cf.* **21** 136] and those of Thomson with *Culex fatigans* [**26** 191] are discussed. *C. fatigans* proved to be more sensitive to humidity than it had been in Thomson's work; adults tested in the flight chamber at 23°C., greatly preferred 73 per cent. relative humidity to 65 per cent., and also preferred 95 to 84 per cent.

Twinn (C. R.). **Report on the 1944 Anopheline Mosquito Survey in Canada.**—*Process. Publ. Div. Ent. Dep. Agric. Can.* no. 17, 52 pp., 2 maps. [Ottawa, Ont.] 1944.

This report deals with a survey made in July–September 1944 of the distribution and abundance of Anopheline mosquitos near 28 service hospitals and

casualty re-training centres and two prisoner-of-war camps in Canada. The organisation is described, and detailed regional reports of the findings are given, in addition to a general summary of the results. This includes a table of the species of mosquitos collected in field surveys and light-traps in 29 districts in seven Provinces and a map showing the distribution of the species of *Anopheles* taken. A further table and a map show the distribution of Anophelines according to records from all sources. There are no records from Prince Edward Island.

The season was unusually dry, but 19,248 mosquitos taken in light-traps were examined, as well as about 5,500 specimens from field surveys, among which larvae predominated. Anophelines comprised 0·85 per cent. of the light-trap catches and 35 per cent. of the material taken in the field surveys, in which other mosquitos were collected only incidentally. Of the 27 mosquito species found, four belonged to the genus *Anopheles* [*cf. R.A.E.*, B **33** 125]. *A. maculipennis* var. *occidentalis*, D. & K., the most widely distributed Anopheline and the only one known to occur in Saskatchewan, Alberta and the Yukon Territory, was recorded for the first time in Nova Scotia and New Brunswick. It is now known from all nine Provinces. *A. punctipennis*, Say, is somewhat less widely distributed, having been recorded from six Provinces, but is equally common in many parts of its range. *A. quadrimaculatus*, Say, is known from Quebec and Ontario. In the present survey, it was taken only in the latter Province, in the southern part of which it occurs widely. *A. walkeri*, Theo., which had previously been recorded only from Quebec, Ontario and Manitoba, was found also in Nova Scotia and New Brunswick, and one female was taken on Vancouver Island. This is the first record of the species from western North America. No examples of *A. maculipennis* var. *freeborni*, Aitken, were collected, but it had previously been recorded from four localities in British Columbia. Of the Canadian Anophelines, only this one and *A. quadrimaculatus* are considered important vectors of malaria in the United States. The information obtained shows that as a whole Anopheline populations in Canada are light, and a paper by L. L. Williams [**32** 131–132] indicated that malaria is not likely to be serious in the northern parts of the United States and disappears even in the southern parts when *A. quadrimaculatus* becomes scarce.

Notes are given on the principal non-Anopheline mosquitos taken. *Culex salinarius*, Coq., and *Uranotaenia sapphirina*, O.-S., were recorded from Canada for the first time.

Household and medical Entomology.—*Rep. Minist. Agric. Can. 1944–45* p. 67. Ottawa, Ont., 1945.

A brief account is given of the Anopheline survey of Canada carried out in 1944 [see preceding abstract], and it is reported that dimethyl phthalate, ethyl hexanediol and 2-phenyl cyclohexanol were among the most effective materials tested as repellents against blood-sucking Diptera, principally mosquitos. Protection was given for periods averaging up to six hours.

Price (M. M.) & Lyman (F. E.). **Second Report on the Control of *Anopheles quadrimaculatus* Say in the Water-chestnut Areas of the Potomac River, 1944.**—*Publ. Hlth Rep.* **60** no. 34 pp. 985–994, 1 map, 1 graph, 1 ref. Washington, D.C., 1945.

In 1943, breeding of *Anopheles quadrimaculatus*, Say, along the Potomac River was successfully controlled near six military establishments by dusting with Paris green from aircraft [*R.A.E.*, B **33** 81]. The amount of dusting

necessary in 1944 was greatly reduced as a result of the cutting of water chestnut [*Trapa natans*]. This work was begun in 1940, and showed that water chestnut can be eliminated from the river by cutting sufficiently early in the year to prevent seeding. Dusting was necessary only near two establishments situated in areas where breeding was taking place in swamps and among uncut water chestnut and where carriers of malaria who had returned from highly malarious theatres of war were stationed. Paris green was applied weekly from 7th July to 22nd September, a total of 7,610 acres being dusted with 8,791 lb. Paris green diluted with 26,349 lb. soapstone. The largest area dusted at one time was 990 acres. The cost per acre was somewhat higher than in 1943, owing to increased overhead expenses resulting from the smaller area treated. Notes are given on the populations of *A. quadrimaculatus* at the various service establishments. Control was satisfactory during the entire season. It is pointed out that cutting water chestnut does not stop Anopheline breeding immediately, because the cut plants form floating mats that are excellent breeding places and they disintegrate slowly.

Papers noticed by Title only.

Cooley (R. A.) & Kohls (G. M.). **The Genus *Ixodes* in North America.**—*Bull. nat. Inst. Hlth* no. 184, iii+246 pp., 87 figs. Washington, D.C., Supt. Documents, 1945. Price 40 *cts.*

Bouvier (G.). **Les Tabanidés de la Suisse.**—*Mitt. schweiz. ent. Ges.* **19** pt. 10 pp. 409–466, 35 figs., 32 refs. Bern, 1945.

Parrot (L.) & Malbrant (R.). **Notes sur les phlébotomes. XLVII. Phlébotomes du Moyen Congo** [collection records and descriptions of one new species and one new variety].—*Arch. Inst. Pasteur Algérie* **23** no. 2 pp. 121–127, 4 figs., 9 refs. Algiers, 1945.

Lenert (L. G.) & Legwen (W. A.). **Construction and Operation of a 4-inch hydraulic Dredge for Malaria Control Drainage.**—*J. nat. Malar. Soc.* **4** no. 2 pp. 93–98. Tallahassee, Fla., 1945.

Jones III (R. W.). **Report on Use of a Diaphragm Pump and Tide Gates on Malaria Control Project at Harvey Point, N.C.**—*J. nat. Malar. Soc.* **4** no. 2 pp. 99–104. Tallahassee, Fla., 1945.

Blanc (G.) & Baltazard (M.). **Contribution à l'étude du comportement des microbes pathogènes chez les insectes hématophages. Premier mémoire** [*Salmonella* spp. and pseudotuberculosis of rodents in *Xenopsylla cheopis*, Roths.].—*Arch. Inst. Pasteur Maroc* **3** pt. 2 pp. 21–49, 11 graphs, 12 refs. [Casablanca] 1944. [For briefer account see *R.A.E.*, B **34** 103.]

Hassall (A.) & others. **Index-catalogue of Medical and Veterinary Zoology. Part 7. Authors : H to Juzuki. Part 8. Authors : K to Kyzer. Part 9. Authors : L to Lyutkevich.**—pp. 1755–2271, 2273–2582, 2583–2966. Washington, D.C., U.S. Dep. Agric., 1946. Prices $1.25, 55 *cts.*, 70 *cts.* (from Supt. Documents). [*Cf. R.A.E.*, B **30** 160.]

KNIPLING (E. F.). **The Development and Use of DDT for the Control of Mosquitoes.**—*J. nat. Malar. Soc.* **4** no. 2 pp. 77–92, 26 refs. Tallahassee, Fla., 1945.

A summary is given of some of the results of research carried out by the United States Bureau of Entomology and Plant Quarantine in 1942–44 on the effectiveness of DDT applied in various forms and by various methods for the control of larvae and adults of Anophelines and other mosquitos [*R.A.E.*, B **34** 98, 128–133, 168, 171, 172; **35** 13, 22, 23].

GORDON (W. M.) & GERBERG (E. J.). **A directional Mosquito Barrier Trap.**—*J. nat. Malar. Soc.* **4** no. 2 pp. 123–125, 1 fig. Tallahassee, Fla., 1945.

The trap described, which was designed to indicate the direction in which the mosquitos caught were flying, consists of four square screens of 18-mesh copper wire supported in a vertical plane in grooved frames at right angles to one another round a post of such a height that the centre of each screen is 5½ ft. above the ground. There are 400 sq. ins. of exposed surface on each face of each screen. The screens are lightly coated with a non-drying varnish at least twice a week in such a way that the mesh is not closed. Thus, very little resistance is offered to wind, and air currents are not reflected. By noting the faces on which mosquitos are caught, it is possible to infer in which direction the breeding grounds of the mosquitos infesting an area lie.

The catches in five of these barrier traps used at a naval air station in Texas in 1942 compared very favourably with catches in two New Jersey light-traps [*R.A.E.*, B **31** 195, etc.] operated nearby. *Aëdes sollicitans*, Wlk., which was abundant on two islands 3–4 miles off shore, comprised 58·8 per cent. of the catch in the barrier traps and 51·3 per cent. of that in the light-traps. Four other species were taken on the barrier traps. The ends of two of the screens in each trap were pointing north-east and south-west, and 88 per cent. of the mosquitos taken were on the south-east side of these screens. The south-east was the direction of the prevailing wind and of the largest breeding areas. There was little or no breeding within half a mile of the traps in any direction.

YOUNG (M. D.) & others. **Studies on imported Malarias: 1. Ability of domestic Mosquitoes to transmit *vivax* Malaria of foreign Origin.**—*J. nat. Malar. Soc.* **4** no. 2 pp. 127–131, 1 ref. Tallahassee, Fla., 1945.

This is the first of a series of reports on studies initiated late in 1943 of the characteristics of strains of *Plasmodium* foreign to the United States and of the ability of females of indigenous species of *Anopheles* to become infected with them and to transmit them [*cf. R.A.E.*, B **28** 221, 247, etc.]. It deals with work on the behaviour of *Plasmodium vivax* in *Anopheles quadrimaculatus*, Say, and *A. maculipennis freeborni*, Aitken, carried out up to the end of September 1944. Out of 99 lots of *A. quadrimaculatus* and 61 of *A. m. freeborni* fed, respectively, on 96 and 55 patients suffering from relapses of malaria caused by *P. vivax* acquired abroad (South Pacific and Mediterranean areas and Trinidad), infection was produced in one or more individuals in 61 and 47 lots, comprising 5,527 and 7,032 females of which 2,489 and 2,581 were dissected and 959 and 1,358 had gut or gland infections or both. The figures for the two species are not strictly comparable as more care was taken to select cases having gametocytes in the peripheral blood for the experiments with *A. m. freeborni* than for some of those with *A. quadrimaculatus*. In attempts to transmit malaria from 32 cases to 59 white patients requiring malaria therapy, 21 of the strains produced infections in 43 patients. Both species of *Anopheles* effected transmission. It is concluded that precautions against the spread of imported malaria are as necessary as against that of indigenous malaria.

(241) Wt. P5/3779 5/47 S.E.R. Ltd. Gp. 432. [2]

MUNSON (S. C.) & YEAGER (J. F.). **Concentration-Survival Time Relationship for Roaches injected with Arsenicals.**—*J. econ. Ent.* **38** no. 6 pp. 634–642, 3 figs., 4 refs. Menasha, Wis., 1945.

The following is based on the authors' summary. When sodium monohydrogen orthoarsenate and sodium metarsenite were injected into large nymphs of *Periplaneta americana*, L., and the concentration was plotted against survival time, hyperbolic curves characterised by a region of inflection and by a critical zone were obtained [*cf. R.A.E.*, B **33** 25]. Lead arsenate gave a curve that exhibited no inflection but did have a critical zone. Sodium arsenate and sodium metarsenite were equally toxic to the cockroaches, except in the higher concentrations where the arsenite was the more toxic, and lead arsenate was less toxic than either. These results are explained by a dissociation hypothesis [*loc. cit.*], according to which the arsenical ions formed by the sodium metarsenite and the sodium arsenate (and probably by the lead arsenate) are equally toxic, and the differences in toxicity between the salts are due largely, if not entirely, to differences in their degree of dissociation. Survival times that agree well with the observed times were calculated by the use of equations based on the dissociation hypothesis.

Methods are suggested for estimating the volume of blood in an insect and for comparing toxicity symptoms caused by different poisons, and suggestions are made as to why such simple expressions as ct=constant, where c is molar concentration and t survival time, may happen to apply to biophysical systems under certain conditions of simplification.

KEARNS (C. W.), INGLE (L.) & METCALF (R. L.). **A new chlorinated Hydrocarbon Insecticide.**—*J. econ. Ent.* **38** no. 6 pp. 661–668, 5 refs. Menasha, Wis., 1945.

An account is given of preliminary experiments on the insecticidal properties of a chlorinated hydrocarbon with the empirical formula $C_{10}H_6Cl_8$, referred to as 1068. It is possibly a mixture of isomers and can readily be obtained as a viscous, colourless, odourless liquid that is easily soluble in all proportions in most organic solvents, including aromatic, aliphatic and chlorinated hydrocarbons, ketones, ethers, esters and alcohols, but is insoluble in water. Its volatility is low, though considerably higher than that of DDT. It has shown no tendency to irritate the skin or mucous membranes. In the presence of weak alkali, 1068 readily loses hydrogen chloride and forms a product that is apparently not toxic to insects, and it should therefore not be used with materials having an alkaline reaction. A solution of any desired strength can be made in almost any type of suitable oil carrier, the most convenient being kerosene, deodorised kerosene [Deobase], fuel oil, xylene and methylated naphthalenes. The addition of small amounts of oil-soluble emulsifiers to such oil solutions makes concentrates from which emulsions can be made by the addition of any desired amount of water. The compound can also be emulsified directly in water by the addition of a soluble emulsifier, but in this case higher proportions of emulsifier must be used. Dusts containing 5 per cent. 1068 or less can be prepared by impregnating talc, clays or other non-alkaline carriers with it.

In laboratory experiments against insects [*cf.* also *R.A.E.*, A **35** 119], 1068 was compared with DDT and the active γ isomer (GBH) of benzene hexachloride [B **33** 130]. To test the duration of the toxicity of deposits of the three compounds to females of *Anopheles quadrimaculatus*, Say, squares of wallboard were treated with emulsified xylene solutions of 1068, DDT or benzene hexachloride containing 40 per cent. GBH to give deposits of 200 mg. 1068 or DDT or 100 mg. GBH per sq. ft. The mosquitos were confined on the boards under dishes. In a typical series of tests, the three substances gave

complete knock-down in 40, 86 and 14 minutes, respectively, immediately after application and in 117, 95 and 140 minutes after 16 weeks. Whereas DDT leaves a crystalline deposit that clings well to porous surfaces but flakes off smooth hard surfaces, 1068 leaves a liquid deposit that clings very well to smooth hard surfaces, but may be absorbed by porous materials. Contact for two minutes with a surface that had been treated with 1068 at 200 mg. per sq. ft. one week previously repeatedly gave complete mortality of females of *A. quadrimaculatus* in 24 hours, whereas contact for five minutes with a surface treated at the same rate and time with DDT gave mortalities ranging from 20 to 55 per cent. in 24 hours. Tests with xylene emulsions and suspensions of acetone solutions in distilled water at 0·1, 0·01 and 0·001 parts 1068, DDT or GBH per million and with dusts on water at 0·001 and 0·0001 lb. active ingredient per acre failed to show any significant differences between the three materials in toxicity to fourth-instar larvae of *A. quadrimaculatus*. All treatments applying 0·1 parts active ingredient per million gave 100 per cent. mortality in 48 hours or less, but the only other treatments that did so were 1068 in xylene emulsion at 0·01 p.p.m. and GBH in the dust at 0·001 lb. per acre.

Tests by the Peet-Grady procedure showed that the concentrations of 1068 and DDT required to give mortalities of 95 and (in brackets) 50 per cent. of adult house-flies [*Musca domestica*, L.] are about 0·05 (0·02) and 0·2 (0·06) per cent. w/v, respectively. To produce paralysis in a high percentage of the flies in 10 minutes without adding appreciably to toxicity, the materials were used in solution in deodorised kerosene with the addition of 1 per cent. by volume of a thiocyanate preparation (Lethane 384 Special [B **33** 22]).

It was assumed from the tests described and others, that the individual fatal dose of 1068 is lower than that of DDT. To verify this assumption, measured dosages of the two compounds in emulsions were applied to the thoracic tergites of adults of *Periplaneta americana*, L. Straight-line dosage-mortality curves obtained by plotting log dosages against mortality probits showed that 1068 is probably three times as toxic as DDT to *P. americana* when applied in this manner. The amounts of DDT and 1068 required to kill 95 (or 50) per cent. of the cockroaches in 120 hours were about 70 (or 38) and 25 (or 14) mmg. per gm. body weight, respectively.

GRANETT (P.) & HAYNES (H. L.). **Insect-repellent Properties of 2-Ethylhexane-diol-1, 3.**—*J. econ. Ent.* **38** no. 6 pp. 671–675, 6 refs. Menasha, Wis., 1945.

Among many chemicals tested at Rutgers University, New Jersey, as repellents against Arthropod vectors of disease, 2-ethylhexanediol-1,3 was outstanding because it combined high repellency with safety for the user. Its physical and chemical properties are briefly described, and specifications for the commercial material are given. It was tested against mosquitos by applying measured quantities, usually 1 cc., to about 100 sq. ins. of skin and exposing the treated surface to hungry females. The time from application to first definite bite was chosen as the protection time. Ethylhexanediol and dimethyl phthalate, which was adopted as the standard of comparison, gave protection for 536 and 455 minutes, respectively, against *Aëdes aegypti*, L., and 60 and 123 minutes against *Anopheles quadrimaculatus*, Say, in the laboratory at 75°F. and 50–60 per cent. relative humidity, and for 352 and 233 minutes against saltmarsh mosquitos, mainly *Aëdes sollicitans*, Wlk., and *A. cantator*, Coq., in the field where 4–30 bites a minute were being received on untreated surfaces. [H. W.] Kumm & Jobbins, working in Panama, obtained protection times of 3–4 hours with ethylhexanediol and 1½–2 hours with dimethyl phthalate against *Anopheles albimanus*, Wied., and B. V. Travis in the South Pacific found them to give protection against *A. farauti*, Lav., for 350 and 40 minutes, respectively. Data published by Travis & H. A. Jones in U.S. Patent No.

2,356,801 are also quoted [*R.A.E.*, B **34** 10]. Varying the amount applied tended to alter repellency accordingly, and when diluents were used, repellency was usually a function of the concentration of the active ingredient in the mixture. Data are given on the protection times obtained against *Aëdes aegypti* with amounts of ethylhexanediol varying from 0·3 to 2 cc. per 100 sq. ins., the latter being the most that can be applied without run-off. The increase in effectiveness observed as more repellent is applied is definite, though not directly proportional.

Under practical conditions, protection is sought for all exposed surfaces and it is usually shorter than in laboratory tests. Numerous factors, including profuse perspiration, probably contribute to this. Ethylhexanediol and dimethyl phthalate gave protection against *A. sollicitans* in the field for 2½–4½ and 2–2½ hours, respectively. The need for covering all surfaces to be protected was demonstrated. Preliminary trials on the application of repellents to clothes indicated that cotton cloth retains them for a long time. Treating slack suits with about 20 per cent. by weight of ethylhexanediol and dimethyl phthalate prevented biting by *A. sollicitans* in the field for up to eight and about two days, respectively. The suits were worn for about half of each working day. When they were stored and worn only for a test lasting about one hour, the repellents remained effective for six and four weeks, respectively. Rain tended to wash them off the cloth.

In tests by various workers, ethylhexanediol and dimethyl phthalate protected for 350 and 316 minutes, respectively, against *Simulium* spp., 240 and 240 minutes against *Phlebotomus* spp., 101 and 47 minutes against *Stomoxys calcitrans*, L., and 139 and 260 minutes against fleas [**33** 107]. On treated suits, they protected against *Acariscus masoni*, Ewing, and species of *Eutrombicula* for about 30 days. Ethylhexanediol provided some protection against *Cimex lectularius*, L., and protected men for 508 minutes and domestic animals for 330 minutes against *Simulium* (*Eusimulium*) *pecuarum*, Riley.

The results are given of experiments on the toxicity of ethylhexanediol to rabbits. It is concluded that it is safe under the conditions recommended for use as a repellent and is not irritating to man, but it should not be applied to sensitive areas such as the eyes or mouth.

Wisecup (C. B.), Brothers (W. C.) & Eide (P. M.). **Airplane Spraying of Rice Fields with DDT to kill Mosquito Larvae.**—*J. econ. Ent.* **38** no. 6 pp. 686–688, 3 refs. Menasha, Wis., 1945.

Large-scale tests of the effectiveness of releasing DDT sprays from aircraft to control larvae of *Anopheles* and *Psorophora* were carried out during the summer of 1944 in rice-fields in east-central Arkansas. In this district, the practice is to flood the young rice early in June, then allow a short dry period and maintain prolonged flooding if possible through July and August. However, it is often impossible to maintain an unbroken body of water at this time, and a series of floodings usually occurs. This provides ideal conditions for *Psorophora*, and most periods of flooding are long enough for large broods of *A. quadrimaculatus*, Say, to emerge. For treatment from aircraft to be economic, it would be necessary to treat large areas together irrespective of the larval populations and presence or absence of water at the time. The effects of treatment of dry fields before flooding and the duration of its effectiveness in flooded fields were therefore important. A water emulsion containing 5 or 10 per cent. DDT, prepared from a concentrate consisting of 25 per cent. DDT, 68 per cent. xylene and 7 per cent. Triton X-100 (an aralkyl polyether alcohol), was applied with a Husman-Longcoy portable spray unit [*cf. R.A.E.*, B **34** 171] from light aeroplanes to more than 700 acres of growing rice. Flying was cross-wind, beginning at the leeward side of the field, and swaths 40 ft. wide were laid.

Larvae of *Psorophora* spp. and *Anopheles* were readily killed by direct application of spray at 0·1–0·2 lb. DDT per acre. The higher dosage used before the fields were flooded prevented development of *Psorophora* larvae, but was of doubtful value against *Anopheles*. Dosages of 0·5 lb. or more controlled all larvae for as much as a month. No damage to rice was observed as a result of these applications. Three types of aircraft tested were all equally satisfactory, and service pilots were able to make applications in open country without special training.

Jones (H. A.), Lindquist (A. W.), Deonier (C. C.) & Husman (C. N.). **Dispersion of DDT Sprays from fast Combat Aircraft.**—*J. econ. Ent.* **38** no. 6 pp. 691–693, 2 refs. Menasha, Wis., 1945.

In preliminary tests in Florida, begun in December 1943, solutions of DDT released from chemical warfare tanks attached to fast combat aircraft flying at 250 m.p.h. gave good control of captive house-flies [*Musca domestica*, L.] and larvae of *Anopheles quadrimaculatus*, Say, and of house-flies subsequently exposed to the deposit on dishes that were placed in the treated area. The tank outlet, which varied somewhat in different tests, is described. Effective swath widths under favourable wind conditions ranged from 150 to 400 yards. It is concluded that an aeroplane flying across the wind and releasing 27·5 U.S. gals. of a 5 per cent. w/v solution of DDT in oil under the conditions of the test would give good control of insects over an area of about 30 acres, assuming an effective swath width of 200 yards and a linear coverage of 700–800 yards. Results were better when a mixture of fuel and lubricating oils was used than with fuel oil alone. Better control was obtained with a 10 per cent. solution of DDT in 30 parts xylene and 35 parts each fuel and lubricating oils than with the 5 per cent. solution. It would seem desirable to use the higher concentration to compensate for the unevenness of the deposit. At the dosage used in the tests, DDT may have injurious effects on fish and wild life. The method is suggested as a convenient and rapid way of protecting troops from mosquitos in forward combat areas.

Fairchild (G. B.) & Barreda (E. A.). **DDT as a Larvicide against** *Simulium*.—*J. econ. Ent.* **38** no. 6 pp. 694–699. Menasha, Wis., 1945.

An account is given of tests of DDT for the control of larvae of *Simulium* spp. in swift-flowing mountain streams in Guatemala. An emulsion containing 4 per cent. DDT made from a concentrate containing 20 per cent. DDT, 20 per cent. Triton X-100 and 60 per cent. xylene, eradicated the larvae from a stream for a distance of 2,000 ft. when poured in over a period of an hour to give an initial concentration of 4·4 parts DDT per million parts water, and lower concentrations effected control over longer distances, the best results being obtained with 0·13 parts DDT per million, which killed all larvae at a distance of over six miles. In a test that was carried out by the junior author and H. Elishawitz and is to be reported separately, the 4 per cent. emulsion was applied at a dosage to give 0·1 part DDT per million parts water to the three rivers and 27 tributary streams in an area nearly 8 sq. miles in extent with a high *Simulium* population. A satisfactory kill was obtained, and the adult population, as estimated by biting rates on human subjects taken over a period of seven weeks, declined more and sooner in the treated than in an adjacent untreated area. The test was inadvertently made at the time of the seasonal decline in population, and this complicated the evaluation of results. Infiltration of adults and overlooking of small seepage or spring-fed streamlets may have helped to maintain the population of adults in the treated area. Reduction of *S. metallicum*, Bellardi, which breeds in fairly large streams, was greater than that of *S. ochraceum*, Wlk., which prefers the smallest streams.

Absorbing emulsions and solutions of DDT on porous substances such as cast plaster blocks and sacks of sawdust, which were then dropped in the stream, was not successful as a means of prolonging larvicidal action, but seemed promising as a method of application for small streams. Trials of turpentine and crude saponin from the berries of the local tree, *Sapindus saponaria*, indicated that they are moderately effective as solvent and emulsifying agent, respectively, and might economically replace xylene and Triton in Guatemala. At about 20°C. [68°F.], 100 cc. commercial turpentine dissolved about 12 gm. DDT. In a single field test, 95 gm. DDT were dissolved in 950 cc. turpentine to which was added 2,835 cc. kerosene to make bulk to facilitate even application, and the solution was poured into a stream over a period of an hour to give a concentration of 0·1 part DDT per million. The turpentine and kerosene could be seen as a thin film on the water for some distance. The next day, only two living Simuliid larvae were found over a distance of 8,600 ft. Since neither turpentine nor kerosene is miscible with water and no emulsifying agent was used, the authors believe that the results observed were due to solution of the DDT in water. DDT is said to be soluble in 10–15 million parts water. In a further test, DDT powder made into a suspension in water with a wetting agent, which was gradually poured into the stream, was shown to give kills as satisfactory as those obtained with emulsions.

TELFORD (H. S.). **DDT as a Chicken Louse Control.**—*J. econ. Ent.* **38** no. 6 pp. 700–703, 5 refs. Menasha, Wis., 1945.

The experiments described were carried out in the summer and early autumn of 1944. No significant reduction in numbers of *Eomenacanthus stramineus*, Nitzsch, or *Menopon gallinae*, L., occurred when 1 gm. DDT was administered orally in gelatine capsules to each of four infested fowls averaging 2,333 gm. in weight. Dipping four birds infested with the same species of lice in an aqueous emulsion containing 0·03 per cent. DDT (with deodorised kerosene as the solvent and Vatsol OT as the emulsifier) gave almost complete control in four hours, and no living lice were found in examinations two and three days later. These hens were then released in an infested flock of about 100 birds and examined 44 and 67 days after treatment. The first examination showed no lice on three birds, and seven individuals of *Menopon* on the fourth which died soon afterwards and was not examined again. The second examination showed no lice on one bird, five individuals of *Eomenacanthus* on the second and a light infestation by both species on the third. Dipping 12 infested fowls in low concentrations of Vatsol OT with or without a solvent gave some initial control of the lice, but populations began to increase again within three days. Spraying 12 fowls individually in laying batteries with a 2·5 per cent. emulsion of DDT (with benzene as the solvent) at 32·8 to 39·1 cc. per bird gave complete control of *E. stramineus*, *M. gallinae* and *Goniocotes gallinae*, Retz. (*hologaster*, Nitzsch) within 40–48 hours, and protected them from reinfestation from an infested flock for 15–19 days, but the birds had developed incipient infestations by the first two species after 33–37 days. Spraying eight fowls individually with 0·7 per cent. sodium fluoride at 31·1 to 32·2 cc. per bird gave no control of *E. stramineus* or *M. gallinae*.

In six of seven flock-spraying trials, emulsions and suspensions containing 2–5 per cent. DDT applied at rates of 22–280 cc. per bird after the hens had gone to roost controlled the three species of lice within periods varying from 36 hours to seven days. In the remaining trial, a 2·5 per cent. DDT emulsion applied at 47 cc. per bird had given complete control of *M. gallinae* but only about 50 per cent. control of *E. stramineus* at the end of six days. From the standpoints of economy and effectiveness, an emulsion or suspension containing 5 per cent. DDT applied at 22–54 cc. per bird is considered the most promising. Spraying floors, roosts and nests in hen houses with a 2·5 per cent. DDT emulsion, at

6·3–20 cc. per sq. ft. gave complete control of all three species of lice on birds in the houses in 26 days. In one trial, a 2 per cent. suspension of DDT sprayed at the rate of 6·3 cc. per sq. ft. gave partial control of all species in 12 days. Dusts containing 2 per cent. DDT applied to the floors, roosts and nests at 0·8–3·9 gm. per sq. ft. and one containing 5 per cent. DDT applied at 0·8 gm. were generally unsatisfactory against the three species of lice, since control was complete in only one trial out of four. *M. gallinae* and *G. gallinae* were more easily controlled by spraying and dusting than *E. stramineus*.

Richardson (C. H.). **Rate of Penetration of Nicotine into the Cockroach from Solutions of various Hydrogen Ion Concentration.**—*J. econ. Ent.* **38** no. 6 pp. 710–711, 3 refs. Menasha, Wis., 1945.

The results are given of experiments carried out in 1935 on the rate at which nicotine penetrates the body surface of *Periplaneta americana*, L., from solutions with different pH values. Adults were submerged for 16 minutes in nicotine solutions adjusted to the desired pH value with sulphuric acid, at a temperature of 25–26°C. [77–78·8°F.], and the head and prothorax were kept above the surface to prevent ingestion. After immersion, the cockroaches were washed to remove the surface nicotine, and the amount absorbed in the entire insect was determined.

The results showed that appreciable quantities of nicotine were absorbed from solutions in which the alkaloid was almost completely ionised and that absorbed nicotine had a definite toxic effect. Comparison with those of previous tests with nicotine vapour indicated that *P. americana* absorbs nicotine more rapidly from the air than from aqueous solutions, which confirms the greater toxicity and greater speed of penetration of nicotine molecules than of ions in a large, resistant, terrestrial insect.

McGovran (E. R.) & Piquett (P. G.). **Toxicity of Benzene Hexachloride to Housefly Larvae.**—*J. econ. Ent.* **38** no. 6 p. 719, 5 refs. Menasha, Wis., 1945.

A brief account is given of a comparison of the toxicity to larvae of *Musca domestica*, L., of benzene hexachloride, DDT, borax and thiourea. A quantity of crushed oats was treated with an acetone solution of benzene hexachloride or DDT to give the desired concentration of toxicant. The acetone was then evaporated, 23 gm. treated oats was placed in each of several glass jars with gauze tops, and 30 ml. of a mixture of yeast, syrup and water was also added to each jar. In tests with borax and thiourea, the same quantities of oats and mixture were used in the jars but the toxicant was dissolved in the water of the mixture. Each jar was stocked with 25 third-instar larvae, and 50 ml. dry sand was placed on the surface of the medium four days later. The jars were kept at 75°F. and 75 per cent. relative humidity, until all surviving larvae had given rise to adults. After preliminary experiments had established the approximate toxicity of the insecticides, each was tested at three concentrations and each test made three times in duplicate. The concentrations in parts per million parts medium that allowed 50 per cent. emergence of adults were found to be 8 for benzene hexachloride, 77 for DDT, 81 for thiourea and 924 for borax.

Carpenter (S. J.). **Artificial Shelters for measuring Densities of** *Anopheles quadrimaculatus*.—*J. econ. Ent.* **38** no. 6 pp. 721–722, 2 figs., 2 refs. Menasha, Wis., 1945.

Descriptions are given of two types of artificial shelter that compared favourably with natural shelters for furnishing data on the abundance of adults

of *Anopheles quadrimaculatus*, Say. The pyramidal shelter was used during 1943 in South Carolina to replace red boxes [*R.A.E.*, B **31** 218]. It is about 6 ft. high, 4 ft. square at the base and 1 ft. square at the top. All four sides are open for about 30 inches from the ground in densely shaded areas, but in partly shaded areas, three sides can be closed, leaving an opening on one side for the collector to enter. This shelter should be used only where shade is available. It yielded much larger catches during 1943 than red boxes and nail kegs [**31** 52] placed nearby. The privy-type shelter, which has the appearance of a small house or outside privy, was used in 1943 in North Carolina and Georgia. It is 4 ft. sq. and 7 ft. high. The front is open to a height of about 30 ins. above the ground to provide an entrance for the collector. Except in well shaded places, a curtain should be hung over the opening so as to extend to within 6–8 ins. of the ground. This type of shelter yielded much larger catches of Anophelines than red boxes in comparable areas, and appears to be more satisfactory than the pyramidal shelter for measuring densities of *A. quadrimaculatus*. It is not claimed that the shelters are preferable to well chosen natural shelters if these are available.

FARRAR (W. W.). **Occurrence of Pacific Coast *Anopheles* in brackish Water.**—*J. econ. Ent.* **38** no. 6 p. 722. Menasha, Wis., 1945.

In June 1944, larvae of *Anopheles maculipennis freeborni*, Aitken, and *A. pseudopunctipennis franciscanus*, McCracken, which normally occur in fresh water, were found in brackish water in a marsh in California extending inland from the Pacific and heavily overgrown with *Salicornia* for 1·5–2 miles from the ocean. *A. p. franciscanus* was the more abundant. *Culex tarsalis*, Coq., was the only other mosquito found breeding in the area. The waters from which the two Anophelines were taken contained chlorides equivalent to 15 and 34 per cent. sea water (77·7 and 181 mg. equivalents per litre), respectively, based on a chloride content of normal sea water of 535 mg. equivalents per litre. Larvae of both had been collected from water reached by the high tides along a beach on the California coast in August 1943. H. N. MacMillen has since found larvae of *A. m. freeborni* and *A. p. franciscanus* in saline concentrations equivalent to 16 and 32 per cent. sea water, respectively, and W. W. Grafton has found the latter in saline concentrations equivalent to 60 per cent. sea water.

HURLBUT (H. S.) & BOHART (R. M.). **Factors affecting the larvicidal Action of DDT on *Culex quinquefasciatus*.**—*J. econ. Ent.* **38** no. 6 p. 725. Menasha, Wis., 1945.

Reports on the use of DDT against the larvae of *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) in the Pacific Area indicate that larger amounts may be needed to control them in foul water than in other situations. This species prefers water with abundant decaying organic matter. In this paper, data obtained in preliminary laboratory experiments with an emulsion of DDT with xylene and Triton are given; in most cases, the larvae were reared in a medium poor or rich in organic content and exposed to the DDT in the same medium or in distilled water soon after they reached the fourth instar. The observations made in the field were substantiated to some extent; DDT at 0·5 part per million gave complete mortality in 24 hours of larvae reared and exposed in a poor medium, but allowed 66 per cent. of those reared and exposed in a rich medium to give rise to adults. Unexpectedly, however, an acceleration of the action of DDT occurred under certain conditions. Thus the mortality percentages in six and (in brackets) 24 hours for larvae reared in a poor medium and exposed to this concentration of DDT in the same medium and in distilled water were 97 (100) and 1 (81), respectively. For larvae reared in a rich medium and exposed to five times the concentration in the same medium and

distilled water they were 70 (95) and 0 (100). An amino acid gave the accelerative effect with DDT in distilled water, but not in the rich medium. No indication of the nature of the inhibitive element was observed. Both accelerative and inhibitive effects were seen in media having the same pH.

Investigations with DDT in California, 1944. A preliminary Report prepared under the Direction of the Division of Entomology and Parasitology.— [2+] 33 pp., 2 figs., 3 refs., multigraph. Berkeley, Calif., Calif. agric. Exp. Sta., 1945.

The greater part of this report deals with experiments against pests of crops [*R.A.E.*, A **35** 110], but it also includes an introduction in which the properties and insecticidal action of DDT are briefly discussed, and the papers noticed below.

Freeborn (S. B.). **Use against household Insects or Insects of medical Importance,** pp. 3–4. Unlike the others, this paper does not deal with experiments in 1944, but consists of a brief review of the forms in which DDT is used and methods of applying it against mosquito larvae, adult mosquitos, flies [*Musca domestica*, L., and *Stomoxys calcitrans*, L.], lice [*Pediculus humanus*, L.], bed-bugs [*Cimex lectularius*, L.], fleas and cockroaches, as well as an ant [A **35** 110]. A dust of 10 per cent. DDT in talc or pyrophyllite rubbed into the fur of pets and a spray of 5 per cent. DDT in kerosene used to treat fowl houses and yards, dog kennels and the floors of rooms and stables are effective against fleas, and persons allergic to flea bites have obtained considerable relief by treating the underclothes with a dust of 10 per cent. DDT in talc. With the exception of the German cockroach [*Blattella germanica*, L.], all the common household cockroaches are readily controlled by the 10 per cent. DDT dust or 5 per cent. DDT spray [*cf.* B **34** 84]. Repeated applications of the spray or use of a 25 per cent. dust will eventually have some effect on populations of *B. germanica*, but there is little to be gained by substituting DDT for sodium fluoride, particularly against this species.

Michelbacher (A. E.), Smith (R. F.) & Smith (G. L.). **Control of Flies in a Dairy Barn with DDT,** pp. 8–9. Early in July 1944, the milk-cooling room and washroom of a cement dairy building in central California that was heavily infested with flies were treated with a spray of 4 per cent. DDT in light oil. All movable equipment was taken away before spraying, and the cooler and sinks were covered for protection. The walls and ceilings were wetted with coarse spray, applied by means of a hand atomiser from which the nozzle had been removed. All flies that entered the treated rooms were killed, and control in these rooms was still very good on 2nd August. The whole building was sprayed on this date, the previously treated rooms in the same way as before and other parts with a spray consisting of 10 lb. of a powder containing 20 per cent. DDT in 100 U.S. gals. water with 6 oz. blood albumin. This mixture was applied through a spray gun at a pressure of about 500 lb. to all inside surfaces of the milk barn and passages and the outside surfaces with the exception of the corrugated iron roof. Foodstuffs were first removed from the milk barn, and feed troughs were thoroughly wetted before and immediately after spraying to wash off all residue. Resulting control was very good. In the mornings, no living flies could be seen until 10 o'clock or later, and it was not necessary to strain the milk. Some flies entered during the afternoon milking, but they were all dead by morning. There was no evidence of a reduction in control until 25th August, when a few living flies were observed on the walls of the milk barn in the mornings. By 21st September, many of the flies that dropped during the night were still alive in the morning, and at the end of the month, some supplementary spraying had to be done on warm days. Some flies were still being killed on 16th October, but control was no longer effective, except in the originally treated rooms, and the whole building was sprayed again on this day. The

milk-cooling room and washroom received a solution of 13 per cent. DDT in oil diluted with water (1 : 50) and the other parts a mixture of 10 lb. of a wettable powder containing 20 per cent. DDT, ½ U.S. gal. light miscible oil and 100 U.S. gals. water, prepared by adding the DDT when the tank was half full and the oil when it was two-thirds full. Excellent control was being maintained on 14th November, the last date of examination before the paper was written.

Broyer (T. C.). **Studies on the possible Effects of DDT on the Growth of Rice and Barley,** p. 31. In view of the use of DDT for mosquito control in irrigated areas, its possible secondary effects on crop production were investigated in the laboratory. The germination of rice seed kept in aerated suspensions of DDT in water at concentrations of 0·1–100 parts per million was not materially affected; the viability of the seed was not markedly impaired by concentrations soluble in aqueous media, or by excess of the insecticide in suspensions in intimate contact with the germinating organism. The growth of various common soil micro-organisms was not significantly affected when they were kept in appropriate media in which were incorporated water suspensions of DDT at concentrations of 10 and 100 p.p.m. Rice and barley sown in tanks in soil that had been treated with an emulsion as recommended for the annual DDT irrigation flooding of rice lands to control mosquito larvae (5 per cent. DDT and 0·5 per cent. emulsifier in no. 2 diesel fuel oil applied at the rate of 1 part in 20 million parts water) germinated normally, and plant growth, including grain production and maturation, was satisfactory. Similar results were obtained with rice when the growing plants were flooded. It is concluded that the recommended treatment for mosquito control is not detrimental to the soil, at least for a few applications.

Roubaud (E.). **Etudes sur les moustiques de la Crau. IV. Facteurs d'éclosion de l'oeuf chez l'***Aëdes caspius* **Pallas.**—*Bull. Soc. Path. exot.* **37** no. 5–6 pp. 153–158, 8 refs. Paris, 1944.

In this paper, which belongs to a series on the mosquitos of Crau [*R.A.E.*, B **31** 86; **33** 62; *cf.* also **31** 14], an account is given of experiments showing that variations of temperature and sudden immersion after drying have a certain effect in stimulating hatching in eggs of *Aëdes caspius*, Pall., but this effect is comparatively slight if more powerful factors are not also involved. The chief of these is the presence in the water of organic matter setting up fermentation. This explains the fact that the severe outbreaks of *A. caspius* observed in nature always originate in waters rich in organic matter. Various stimuli combined had more marked effect than any one alone. Eggs that had been submitted for more than a month to low outdoor winter temperatures at Paris (an average of 8–10°C. [46·4–50°F.] falling to about 0°C. [32°F.] on some days) reacted much more readily to subsequent stimuli than others that had not been exposed to cold.

Roubaud (E.) & Treillard (M.). **Etudes sur les moustiques de la Crau. V. L'***Aëdes caspius*.—*Bull. Soc. Path. exot.* **37** no. 5–6 pp. 159–169, 15 refs. Paris, 1944.

Aëdes caspius, Pall., is the most abundant and widespread mosquito of Crau [*cf. R.A.E.*, B **31** 14]. It is plentiful in the interior and even in towns, as well as along the coast. Observations made in 1942 are recorded showing that the adults found in the interior develop in fresh water in marshes, ponds, and rain-water pools and do not migrate in vast numbers from salt-water breeding places near the coast. They develop chiefly in spring and September, the periods of highest rainfall, and their breeding places are mostly temporary. Females found in summer are thought to be old ones that emerged in spring. They are very aggressive, and experiments are described showing that they need only one

blood meal to mature their eggs, whereas females taken in spring, which are not aggressive, need several blood meals. In the salt marshes of the coast, *A. caspius* appears to develop continuously throughout the hot season. It was shown experimentally that there was no difference between individuals reared in fresh and those reared in salt water. The two media were equally favourable ; development depended on an adequate supply of organic matter as larval food. Unlike eggs of *A. detritus*, Hal. [*cf.* **33** 62], those of *A. caspius* do not hatch readily when put into clean water after remaining dry for a few days, but need a long diapause or period out of water followed by sudden immersion [*cf.* preceding abstract]. Control of *A. caspius* in Crau can be effected only by drainage.

Sautet (J.) & Witkowski (M.). **A propos d'un *Ornithodorus* trouvé à Gao.**—*Bull. Soc. Path. exot.* **37** no. 5–6 pp. 182–188, 4 pls., 3 figs., 8 refs. Paris, 1944.

Descriptions are given of the eggs, larvae and adults of *Ornithodoros erraticus* var. *sonrai*, Sautet & Witkowski, with notes on the duration of stages of its development [*R.A.E.*, B **35** 45]. Some confirmation of the view that it represents at least a distinct variety was afforded by the fact that when three males of *sonrai* and a female of typical *erraticus* were kept together for a month, mating took place but no offspring were produced. Moreover, *sonrai* failed in two experiments to transmit to guineapigs the spirochaete of Libano-Syrian relapsing fever [which is considered to belong to the group of *Spirochaeta hispanica* (**31** 242)].

Gaschen (H.). **La répartition des tsétsés en fonction du climat.**—*Bull. Soc. Path. exot.* **37** no. 5–6 pp. 172–175, 5 refs. Paris, 1944. **L'utilité du climogramme pour l'étude de la biologie des tsétsés.**—*T.c.* pp. 176–180, 1 graph. **Variations saisonnières des tsétsés.**—*T.c.* no. 7–8 pp. 250–253, 2 graphs.

In the first paper, the author deals with the effect of variations in climate on vegetation and consequently on the distribution of *Glossina* spp., as studied in five different localities in the Ivory Coast by means of climograms. These are dodecagons of which the successive angles have for co-ordinates the mean temperature and relative humidity of a given place for the successive months of the year. The localities were on a line stretching from the Atlantic to the French Sudan. The first was in the tropical forest zone and had a hot, damp, uniform climate. The second was on the borders of the tropical forest and had almost the same temperature range but sometimes a lower humidity. The third was in the riverine forest zone and was equally hot and much drier. The fourth was in the transition zone between riverine forest and savannah and did not differ greatly from the third in climate. The fifth was in the savannah near Waghadugu and was somewhat hotter and very much drier than the other four. The findings are shown in a table in the second paper. *G. pallicera*, Big., occurred in the first locality, *G. longipalpis*, Wied., *G. fusca*, Wlk., and *G. nigrofusca*, Newst., in the first two, *G. palpalis*, R.-D., in all except the fifth, and *G. tachinoides*, Westw., and *G. morsitans submorsitans*, Newst., in the third, fourth and fifth.

In the second paper, the optimum climates for *G. palpalis*, *G. tachinoides* and *G. morsitans submorsitans* are compared by means of climograms, built up from the means of temperature and relative humidity of 9–14 localities in which each species occurred. It is pointed out that the superposition of the climographs for a locality and for a species of *Glossina* can indicate the likelihood of the species becoming established in the locality. An exact knowledge of the climatic requirements of a species is also necessary before attempts can be made to control it by modifying the micro-climate.

In the discussion that followed (pp. 180–182), Bouet stated that after extensive clearing at the intersection of roads and water courses, tsetses congregated under bridges and sometimes remained there for several months. It is therefore recommended that they should be smoked out of these refuges, in order either to repel or kill them.

In the third paper are given the results of investigations during 1938–41 on the relationship between climate and seasonal variations in the abundance of adults of *G. palpalis* in the transition zone between riverine forest and savannah and of *G. tachinoides*, which the author considers a xerophilous species, in the savannah near Waghadugu. The numbers of *G. palpalis* are shown to rise while humidity is rising and temperature is falling. The author concludes that pupal development is favoured by high temperature and high humidity, but that the effect of high temperature in nature is counteracted by low relative humidity. Moreover, the pupae occur under dense vegetation that protects the soil from the rays of the sun and thus causes warming to be delayed. The fact that the population reaches its maximum some two months before relative humidity is attributed to the high rainfall that occurs when humidity is highest, drowning the pupae and enabling the adults to increase their area of dispersal. *G. tachinoides*, the pupae of which are found in sandy soil under scanty vegetation, is most abundant before temperature is at its maximum and when relative humidity is very low, as the effect of the sun on the soil causes early emergence and underground water supplies humidity.

In the discussion (pp. 253–256), E. Roubaud expresses the opinion that the ability of *G. tachinoides* to survive where *G. palpalis* does not is due to its tolerance of high temperature rather than of low relative humidity. Like *G. palpalis* it can withstand a degree of humidity approaching saturation, which a typically xerophilous species cannot, and it frequents the edges of water courses. He criticises Gaschen for basing his conclusions on regional and not microclimatic data, and suggests that the concentration of the flies near water owing to seasonal dryness is responsible for the apparently large population when humidity is lowest.

GIRARD (G.). **Au sujet du xénodiagnostic de l'infection pesteuse. Son intérêt doctrinal.**—*Bull. Soc. Path. exot.* **37** no. 7–8 pp. 194–199, 6 refs. Paris, 1944.

G. Blanc & M. Baltazard, in the course of experiments with Whitmore's bacillus [*cf. R.A.E.*, B **30** 57], showed that when the temperature of an infected guineapig begins to rise and adenitis sets in, the presence of the bacilli in the blood can be demonstrated by xenodiagnosis. Fleas allowed to feed on the guineapig acquire the infection, whereas culture of the heart blood is consistently negative. This led them to suggest that xenodiagnosis might demonstrate plague infection in a man when blood culture does not reveal the degree of bacteraemia theoretically adequate for the infection of fleas (20,000 bacteria per cc.). The author points out that although blood culture is often positive at the beginning of illness, it cannot be said that septicaemia is present, for the culture becomes positive only after several days and the time required for the plague bacillus to develop on broth is primarily a function of the number of bacteria sown. If the blood could infect a flea, it would contain at least 20,000 per cc., and as 5–10 cc. are taken for a culture, it could be inferred that 100,000–200,000 bacteria may not suffice for a positive culture. The ability of the flea to digest antibodies that could destroy the bacteria in a culture might account for this.

However, there are no facts to support an analogy between the conditions of infection of fleas with Whitmore's bacillus and that of plague. Against it there is the evidence obtained by C. R. Eskey, who worked with large numbers of fleas of various species and guineapigs in the septicaemic stage, and failed to obtain infection in 40 per cent. of his experiments [*cf.* **26** 87; **28** 27]. No

guineapig of which the blood culture was negative infected fleas, and only a few fleas became infected after feeding on guineapigs that subsequently survived for more than 18 hours. Less than half the fleas became infected when blood smears showed an infection equivalent to several million bacteria per cc. in the blood on which they fed. Cultures of very small quantities of such blood become positive very rapidly, whereas those of a hundred times as much human blood become positive only after several days unless it is taken just before death.

The author failed to infect *Synopsyllus fonquernii*, Wagn. & Roub., on white rats that gave a positive culture, but the fleas became infected on guineapigs, which always show a more severe septicaemia than rats or mice in experimental, acute plague.

NICOLLE (P.). **Dispositif permettant la réalisation facile des transmissions infectieuses par voie orale chez les réduvidés hémophages.**—*Bull. Soc. Path. exot.* **37** no. 7–8 pp. 238–240, 1 fig., 4 refs. Paris, 1944.

COLAS-BELCOUR (J.) & NICOLLE (P.). **Infestation expérimentale, par voie digestive, de triatomes avec un *Leptomonas* parasite de *Pyrrhocoris apterus* L.**—*T. c.* pp. 240–245, 15 refs.

The apparatus described in the first paper enables Triatomines to feed through a membrane on a liquid warmed to a temperature that attracts them. It is thus similar in principle to one already noticed [*R.A.E.*, B **30** 178], but as it requires a much smaller quantity of liquid, it is more convenient for infection experiments and less convenient for rearing numbers of bugs on a nutrient solution. It was used in the experiments described in the second paper, in which nymphs and adults of *Triatoma infestans*, Klug, and *T. pallidipennis*, Stål, were infected with *Leptomonas pyrrhocoris* by the ingestion of intestinal contents of its host, *Pyrrhocoris apterus*, L. The flagellates were more or less localised in the terminal part of the intestine of the new host, where they remained and multiplied, despite subsequent feeds and moults. They survived four serial passages without decrease of their powers of reproduction. They were present in the fresh dejecta of the bugs, but were not transmitted from one bug to another by contact. It is suggested that *Pyrrhocoris* may obtain its flagellates from plants [*cf. R.A.E.*, B **9** 106] and that their easy adaptation to a blood-sucking insect may be the first step towards their adaptation to the vertebrate hosts of the latter.

LAVIER (G.) & DAO-VAN-TY. **Comportement anormal de certains *Aëdes* pendant l'été de 1943.**—*Bull. Soc. Path. exot.* **37** no. 7–8 pp. 245–250, 2 figs. Paris, 1944.

Mosquitos of the genus *Aëdes* breed in large numbers in a marsh in a valley in the plateau of Beauce, south of Paris, but do not usually cause much annoyance as they remain near the marsh, bite in built-up areas only in the morning and evening and do not enter houses. In 1943, however, adults appeared in the marsh very early in the season, and from about 10th July onwards left their breeding areas and bit in the open air and in houses throughout the day. *A. maculatus*, Mg. (*cantans*, Mg.) and *A. communis*, Deg., were abundant in ground-floor rooms and entered rooms on the first floor in considerable numbers. They were found in houses until the end of September, and biting in the open at great distances from the marsh continued until the beginning of November. Other records of species of *Aëdes* entering houses in England and France are cited; each concerns only a small number of individuals. The outbreak recorded in this paper is attributed to climatic conditions. The preceding winter was abnormally mild, the spring dry until May, when rain

was heavy, and the summer hot. The overwintering generation developed and oviposited early, and the eggs hatched with the May rains and produced a summer generation, the adults of which, on account of their large numbers, were forced to go further than usual from their breeding places for food.

MARNEFFE (H.) & SAUTET (J.). **Infestation sporozoitique naturelle d'*Anopheles gambiae*, Giles, 1902, au Soudan français.**—*Bull. Soc. Path. exot.* **37** (1944) no. 9–10 pp. 315–316, 3 refs. Paris, 1945.

In the course of a malaria survey made in September and October 1942, on the Middle Niger, French Sudan, one female of *Anopheles gambiae*, Giles, out of 90 taken in native huts was found to be infected with sporozoites. This is thought to be the first time that natural infection of *A. gambiae* with malaria parasites has been demonstrated in the French colonies in Africa.

GRENIER (P.). **Observations biologiques sur *Simulium costatum* Fried., (Dipt.). I. L'hibernation.**—*Bull. Soc. Path. exot.* **37** (1944) no. 11–12 pp. 363–374, 16 refs. Paris, 1945.

The following is based on the author's summary. A study of a hibernating population of *Simulium costatum*, Fried., in a shallow brook near Paris showed that the winter is passed in the larval stage, and larvae of all instars are found throughout the season [*cf. R.A.E.*, B **34** 208]. The larvae cannot survive in a block of ice though they can live for a long time under a layer of ice. The population, which is very dense at the beginning of winter, tends to decrease gradually throughout the period of hibernation. Sustained study showed that larval growth continued, though slowly, at water temperatures of 6–8°C. [42·8–46·4°F.] and occasional pupae appeared at the beginning of February. A few pupal exuviae were found on 16th March 1944. The capture of adults of other species that had emerged from such early pupae may have led to the belief held by some workers that hibernation occurs in the adult stage.

Observations in the laboratory indicated that development, which had been considerably retarded, was not immediately accelerated when optimum conditions of temperature and food were provided. There is thus a similarity in this respect between *S. costatum* and *Anopheles plumbeus*, Steph. [*R.A.E.*, B **21** 232]. Some individuals were found in the early larval instars at the end of winter and the beginning of spring. These seem to have undergone a complete cessation of development through most of the hibernation period.

It has been thought that *S. costatum* has two generations a year in France, with adults emerging chiefly in spring and September, but the appearance of numerous first-instar larvae about the end of May, together with the continuous flights of adults from the end of winter until the end of June, indicates that there is at least one small additional generation.

Rapport sur le fonctionnement de l'Institut Pasteur du Maroc 1944.—42 pp., 1 fig., 1 ref. [Casablanca, 1945.]

The experiments described in this report include one in which a United States strain of tularaemia was transmitted from infected laboratory animals to a guineapig by *Xenopsylla cheopis*, Roths., another in which inoculation into guineapigs of two lots of *Pedicinus albidus*, Rudow (comprising 50 and 150 examples, respectively) taken from monkeys (*Macaca sylvana*) that died of plague produced the disease in the guineapigs, and a third in which excreta of *X. cheopis* collected from rats kept in a vat in which a strain of plague was being maintained caused fatal plague in guineapigs into which they were injected 24 hours, 122, 199, 315 days and one year after collection.

Hase (A.). **Weitere Beiträge zur Kenntnis der Kleiderlaus ; insbesondere über Kotschnurenbildung.** [Further Contributions to the Knowledge of the Clothes Louse ; in particular the Formation of Strings of Excrement.] —*Z. Parasitenk.* **13** pt. 2 pp. 150–155, 4 figs., 12 refs. Berlin, 1944.

Studies on the control of *Pediculus humanus humanus*, L. (*P. vestimenti*, Nitzsch) have shown that one indication that the lice are moribund is the appearance of long strings of excreta [*R.A.E.*, B **31** 8], and various cases of this are described and figured. Detailed observations have shown that this abnormal formation is an indication of digestive disturbance, and that this may be caused by unfavourably high temperature or low atmospheric pressure, hunger, or the action of contact or respiratory poisons. Both immature and adult lice are affected.

Pavlov (P.). **Untersuchungen über einen *Ornithodorus* (*Alveonasus*) vom Schaf aus Mazedonien.** [Investigations on an *Ornithodoros* on Sheep in Macedonia.]—*Z. Parasitenk.* **13** pt. 2 pp. 177–182, 3 figs., 10 refs. Berlin, 1944.

In April 1943, nymphs of a tick subsequently identified as closely allied to, or possibly a subspecies of, *Ornithodoros* (*Alveonasus*) *lahorensis*, Neum., were found on sheep in two localities near Monastir in Jugoslavia. Although no species of *Ornithodoros* had previously been recorded on a mammal in the Balkans, the ticks had been known to local shepherds for about ten years. They were abundant in the sheep pens, where nymphs and adults occurred in dark corners and between the unbaked clay bricks of the walls, but were not found in neighbouring buildings, stables, cattle-sheds or the holes of rodents, or on sheep-dogs that slept in the pens. They occurred on the backs of the sheep, from head to tail, in an area extending about 4 ins. on either side of the spine. The shepherds reported that larvae and nymphs were present on the sheep from early November to early April, indicating that development does not take place at this season [*cf. R.A.E.*, B **25** 122]. Larvae in the process of moulting were observed at the end of April. In the laboratory, the ticks engorged freely on rodents, pigeons and hens, attaching themselves to any part of the body. After feeding, they moved to another place and emitted coxal fluid. Ticks given a second blood meal a fortnight later ingested less blood than at the first meal. Sheep attacked by numerous ticks became anaemic and emaciated, but recovered when the ticks were removed.

Since this tick is the only species of *Ornithodoros* that has been found on mammals in the Balkan Peninsula, it may prove to be the vector of *Spirochaeta hispanica* var. *peloponesica* [*cf.* **25** 24], but no spirochaetes were found in man, sheep, dogs or rodents in the region where it occurred, in the coxal fluid of the ticks or in guineapigs on which they fed.

Brown (J. H.). **The Rabbit Tick, *Haemaphysalis leporis-palustris* Pack., as an Ectoparasite of Man.**—*Canad. Ent.* **77** no. 9 p. 176. Guelph, Ont., 1946.

On 9th February 1945, a railway worker in Alberta, who had handled about 13 rabbits during the winter, found a half-engorged tick attached to the inside of his left forearm. There was a lesion where the tick was attached and another just below it. The author identified the tick as *Haemaphysalis leporis-palustris*, Pack., which has not previously been known to feed on man. As tularaemia is well established in the part of Alberta where the infestation was acquired, the tick was ground up and injected into a guineapig, but no indication of infection was found.

BEKKER (P. M.) & GRAF (H.). **Gammexane and D.D.T. Dips for Control of Arsenic-resistant Blue Tick.**—*Fmg in S. Afr.* **21** no. 243 pp. 361–366. 420, 4 refs. Pretoria, 1946.

A preliminary account is given of experiments made in East London, Eastern Cape Province, with benzene hexachloride (666) and DDT in dips for the control of the arsenic-resistant strain of *Boophilus decoloratus*, Koch. This strain was first seen near there in 1937 and has since become prevalent in practically the whole coastal belt from Alexandria to the north of Natal and Zululand. Tests in 1940–41 had shown that it could be controlled by the weekly use of an arsenical dip containing 0·04 per cent. nicotine [*R.A.E.*, B **35** 35], but owing to the scarcity of nicotine, an alternative was required. The solvents and emulsifiers used for the concentrates are not given, but the DDT concentrate contained at first 25 per cent. and then 20 per cent. of the active para-para isomer, and the benzene-hexachloride concentrate was prepared from a technical product assumed to contain 10 per cent. of the active γ isomer [*cf.* **33** 130], diluted to contain at first 1·25 and then 1 per cent. of this isomer. Dipping was carried out weekly, and some of the dips also contained arsenic, while others did not.

DDT at 0·5 per cent. without arsenic gave fairly good control of a heavy infestation at the first dipping and practically complete control at the second. Fewer eggs than usual were laid by females that survived the first dipping and many did not hatch. The dip apparently protected the animals from reinfestation for 12 days. It killed *Rhipicephalus evertsi*, Neum., but did not prevent re-infestation by adults within 24 hours. It was also effective against *Siphona* (*Lyperosia*) *irritans*, L., which was abundant at the first dipping, much less so at the second and absent at subsequent ones. The emulsion kept well, but there was some precipitation. The dip at first had an irritating effect on the cattle, but they soon became accustomed to it. At 0·1 per cent., DDT in a seven-day strength arsenical dip gave fairly good control of *B. decoloratus* but practically no protection against re-infestation. The presence of the arsenic apparently helped to stabilise the emulsion. No ill effects to the animals were noticed with this strength. DDT at 0·05 per cent. in the arsenical dip had some effect on the tick, but a considerable number remained after the fifth dipping.

The benzene hexachloride at 0·005 per cent. of the active isomer in the arsenical dip gave complete control on heavily infested cows. All larvae and nymphs were dead in 24 hours. However, weekly dipping was necessary, as there was no appreciable protection from reinfestation. The emulsion did not decompose. Females that had undergone dipping laid a reduced number of eggs, none of which had hatched in 11 weeks. No harmful effect on the cattle was noticed. The dip had no marked effect on *S. irritans*. Emulsions containing 0·0025 and 0·001 per cent. active isomer without arsenic were moderately effective at first, but began to break down at the fourth dipping. It is not known whether the changes were due to decomposition of the compound itself or the emulsion only. More information will have to be obtained before DDT and benzene hexachloride can be definitely recommended as stock dips.

PAPERS NOTICED BY TITLE ONLY.

GOODHUE (L. D.), BALLINGER (W. R.) & FALES (J. H.). **Improved Dispenser for testing new Liquefied-gas Aerosols.**—*J. econ. Ent.* **38** no. 6 pp. 709–710, 1 fig., 4 refs. Menasha, Wis., 1945. [*Cf. R.A.E.*, B **32** 99.]

WATERHOUSE (D. F.). **Studies of the Physiology and Toxicology of Blowflies. 10. A histochemical Examination of the Distribution of Copper in *Lucilia cuprina*. 11. A quantitative Investigation of the Copper Content of *Lucilia cuprina*.**—*Bull. Coun. sci. industr. Res. Aust.* no. 191, 39 pp., 1 pl., 4 figs., many refs., multigraph. Melbourne, 1945.

[Klenin (I. I.).] **Кленин (И. И.). Comparative Effectiveness of chemical Disinfectants for the Control of Mange.** [*In Russian.*]—*Veterinariya* **22** no. 11–12 pp. 36–37. Moscow, 1945.

The results are given of tests of disinfectants for the control of mange mites off their hosts, in which larvae, nymphs and adults of *Psoroptes ovis*, Hering, from sheep, or *P. equi*, Hering, and *Sarcoptes caballi*, Oudm. (*Acarus equi*, Gerl.) from horses were immersed in the fluids under investigation at different temperatures and then kept for up to 30 hours at 16–19°C. [60·8–66·2°F.]. A 3 per cent. emulsion of creolin killed all stages of *P. equi* and *P. ovis* in 3 minutes at 45°C. [113°F.] and 39°C. [102·2°F.], respectively, but was less effective at lower temperatures. A 5 per cent. emulsion killed all stages of *P. equi* in 3 minutes at 42°C. [107·6°F.] and of *P. ovis* in 3–5 minutes at 40–45°C. [104–113°F.] and in 10 minutes at 36°C. [96·8°F.]. It was also less effective at lower temperatures. It killed *S. caballi* (against which it was the only treatment tested) in 3 or 5 minutes at 35–38°C. [95–100·4°F.]. The other disinfectants, which were tested only against *P. equi*, were either slower in action against the adults at 45°C. or ineffective at lower temperatures. Immersion in water alone for 2–3 minutes killed all the adults at 70°C. [158°F.] but not at 60°C. [140°F.].

[Machul'skiĭ (S. N.) & Suetin (V. Ya.).] **Мачульский (С. Н.) и Суетин (В. Я.). Antiskobin—a new antimange Preparation.** [*In Russian.*]—*Veterinariya* **23** no. 1 p. 40. Moscow, 1946.

Over a hundred head of cattle in the Republic of the Buryat-Mongols were freed from *Psoroptes* [*bovis*, Gerl.] by a liniment known as Antiskobin. It is prepared by mixing infusorial earth or ash with water, allowing the mixture to stand in a different container, pouring the liquid away and heating the sediment until it is dry. A fine clay or ash powder is obtained, of which 35 parts by weight are triturated with 5 parts tar oil and mixed with 20–25 parts water. This liniment was rubbed into the affected parts after the scabs had been removed and the hair clipped for 2–3 ins. round the infested areas, and the treatment was repeated a week later. It had no ill-effect on the animals ; a slight dermatitis that developed on some of them soon passed.

[Bauman (V. V.).] **Бауман (В. В.). The Viability of the Eggs of *Psoroptes* Mites at low Temperatures.** [*In Russian.*]—*Veterinariya* **23** no. 2–3 p. 27, 1 ref. Moscow, 1946.

In view of the findings of Lamikhov on the effect of cold on mange mites [*R.A.E.*, B **34** 95], the experiments described were carried out in the winters of 1942 and 1943 in the south of the Province of Ural to find the periods of exposure to cold required to kill eggs of *Psoroptes equi*, Hering, *P. ovis*, Hering, and *P. bovis*, Gerl. The periods, which are given for a series of temperatures, ranged from five days at 0 to −5°C. [32 to 23°F.] to 2–4 hours at −20 to −25°C. [−4 to −13°F.].

[Mekhtiev (A. A.).] **Мехтиев (А. А.). Experiments in the local Treatment of Camels suffering from Mange.** [*In Russian.*]—*Veterinariya* **23** no. 2–3 p. 29. Moscow, 1946.

The finding of D. L. Voronov that mange can be cured by treating only the parts of an animal affected by it [*R.A.E.*, B **34** 11] was confirmed in work by the author in which 120 camels were freed from unspecified mange mites by applying creolin liniment to the infested areas four or five times at intervals of 7–10 days in November and December, after the usual preliminary preparation of the areas for treatment. No symptoms of mange were evident when the animals were examined in the following April and May.

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POTGIETER (J. T.). **Blow-flies and Flies in Towns.**—*Fmg in S. Afr.* 1945 repr. no 1, 4 pp., 1 fig. Pretoria, 1945.

General intensive action is necessary for the control of flies on account of the part they play in the transmission of disease, especially as certain species are suspected of transmitting poliomyelitis [*cf. R.A.E.*, B **33** 126, etc.], which has occurred almost in epidemic form in various parts of South Africa. It will probably be necessary to carry out some sort of control in most of the towns in the Union throughout the year, and not only in summer. The numbers of various kinds of flies caught in three traps baited with internal organs of sheep and set up in different parts of Stellenbosch, two from 13th October to 21st November 1944 and one from 6th to 21st November, are shown in tables. The total numbers were 7,840 of *Lucilia cuprina*, Wied., 3,497 of *L. sericata*, Mg., 1,587 of *Chrysomyia albiceps*, Wied., 48,163 of *C. chloropyga*, Wied., 5 of *C. marginalis*, Wied., and 43,495 of other flies. The first four species attack sheep, but *C. marginalis* is beneficial as its larvae exclude those of the others from carcases [*cf.* **33** 28, etc.]. It is suggested that sheep-farmers should use traps only when *C. marginalis* is absent or scarce. The fact that blowflies that can breed only on carrion or sheep occur in such large numbers in a town shows that enough dead birds or animals and other breeding material occur to support the immature stages, and that *C. marginalis* cannot always compete successfully with them as it usually does on farms.

A description is given of an effective trap that is similar in principle to one already noticed [**22** 23] but is made of two petrol tins. Intestines of sheep with some of the contents exposed together with a small piece of liver or lung make a suitable bait, but poultry intestines seem even more attractive. The bait should be kept moist and renewed weekly, or possibly more often in towns to avoid unpleasant odours. Usually a weak tobacco extract or a 1 per cent. solution of sodium arsenite in water is used in the trap to kill any maggots that may be present in the bait, but to eliminate the use of poison in towns, it is recommended that the bait should be treated with boiling water or kerosene in water before removal.

Apart from blowfly control, the usual measures to control house-flies [*Musca domestica*, L.] indoors and to prevent their breeding in manure or kitchen refuse should be maintained. A poison bait of 4 oz. sodium arsenite, 2½ lb. white sugar and 2½ gals. water applied to leafy branches or pieces of sacking is effective against flies that breed in manure, and should be used in stables and near manure and compost heaps. It should be renewed every few days.

SMIT (B.). **The new D.D.T. Insecticide.**—*Fmg in S. Afr.* **20** no. 231 pp. 337–340, 356. Pretoria, 1945.

The inside of the windows of a kitchen in Pretoria, which had an area of some 40 sq. ft., were sprayed on 30th August 1944 with about 10 cc. of a 5 per cent. solution of DDT in kerosene. The deposit was hardly noticeable. Flies showing characteristic signs of DDT poisoning were lying on the sill half an hour later, and the kitchen remained virtually free of flies from the time of spraying until the windows were washed on 7th November. Every fly that entered the kitchen during this period was killed, and there was some effect even after 7th November. The insects that died against the windows before this date comprised 154 house-flies (*Musca domestica*, L.), 41 blowflies, 12 other flies and six honey bees. A room in Pretoria heavily infested with bed-bugs [*Cimex lectularius*, L.] was sprayed with about ½ gal. of the 5 per cent. solution of DDT on 30th December. The room was 10 ft. square with a smooth cement floor and smooth plastered walls, and the bedstead was iron. The walls, bed and both sides of the mattress were treated. Three moribund adult bugs and five

nymphs were recovered the next day, and no further sign of infestation had been found up to April 1945, though the room had been constantly occupied.

Dusting with 5 per cent. DDT in talc was tried in a kitchen heavily infested with cockroaches, but though the powder made a fine cloud and many cockroaches in all stages of development were coated, many of the least affected escaped. Seven adults that were grey with powder when collected survived for at least two days. They were then on their backs and eventually died, but the four females carrying egg-cases had dropped them, and a large number of healthy nymphs developed from the eggs. In another experiment, cockroaches placed in a jar on a piece of blotting paper dusted with the powder thrived on a diet of wet bread for several weeks. Dusting the cupboards and storage space of a printing works with the 5 per cent. powder drove the cockroaches from place to place in the building, but did not seem to control them.

HADDOW (A. J.), GILLETT (J. D.) & HIGHTON (R. B.). **The Mosquitoes of Bwamba County, Uganda. V. The vertical Distribution and Biting-cycle of Mosquitoes in Rain-forest, with further Observations on Microclimate.**—*Bull. ent. Res.* **37** pt. 3 pp. 301–330, 2 pls., 11 figs., 14 refs. London, 1947.

During field investigations on the epidemiology of yellow fever in Bwamba County, western Uganda [*cf. R.A.E.*, B **33** 189 ; **34** 28, 159], the virus has been isolated from man and *Aëdes simpsoni*, Theo. [**31** 61] and from a mixed lot of *Aëdes* spp. taken in uninhabited rain-forest [**34** 28]. A list is given of the 12 species included in this mixed lot. All were scarce or had a restricted distribution except *A. apicoargenteus*, Theo., *A. argenteopunctatus*, Theo., *A. cumminsi*, Theo., and *A. africanus*, Theo. As yellow fever is endemic among the monkeys of the Bwamba forests and there is a high rate of immunity among species that avoid inhabited or cultivated districts and rarely descend to the ground, it was thought that *A. simpsoni*, which is not a sylvan species, could not maintain the infection among them, and that the vector must be an arboreal species [*cf.* **32** 183–184]. An investigation of these was therefore begun. Descriptions are given of the Mongiro area of the Semliki forest and the adjacent Mamirimiri area, which were finally chosen for the work. The former has a remarkably large and varied monkey population. The investigation consisted of 24-hour catches carried out simultaneously at ground level and on tree-platforms of various heights up to 82 feet ; 20 such catches were made during the rains and 20 in the dry season, and detailed data are given on them. There were no significant differences between the biting cycles at different levels or at Mongiro and Mamirimiri.

Anopheles gambiae, Giles, was by far the commonest mosquito at all levels [*cf.* **33** 189]. Over 30,000 (93 per cent. of the total for all species) were taken. Its vertical distribution was essentially the same in the wet and dry seasons. It could be collected in tents even more readily than in the open. The females bit mainly at ground level and between midnight and dawn, and the biting rate increased fairly steadily throughout the night. *A. funestus*, Giles, was taken at all levels, but only in small numbers. It is probable that this species and *A. pharoensis*, Theo., migrate into the forest from swampy breeding places outside it. Various species of *Mansonia* (*Taeniorhynchus*) attack man viciously in the Semliki forest, and several were taken above ground level. *M.* (*T.*) *africana*, Theo., which has transmitted yellow fever in the laboratory [**18** 147] and has a wide distribution and long flight range and bites freely, was present in fair numbers at heights of over 50 ft. It is concluded that it occurs in the forest canopy sufficiently consistently and in numbers large enough to be of importance.

Within the genus *Aëdes*, members of the subgenera *Aëdimorphus* (except *A. natronius*, Edw.) and *Banksinella* bit mainly at ground level, while species of *Mucidus*, *Finlaya* and *Stegomyia* had distinct arboreal tendencies, which

were particularly well-marked in *A. grahami*, Theo., *A. longipalpis*, Grünb., *A. apicoargenteus* and *A. africanus*. Species of the group of *A. tarsalis*, Newst. (*A. tarsalis* and *A. albocephalus*, Theo.) were the most abundant non-Anophelines at Mongiro throughout the year, but their preference for biting at ground level makes it unlikely that they play an important part in the local epidemiology of yellow fever among monkeys. *A. africanus* was by far the most abundant arboreal mosquito apart from *Anopheles gambiae*. It attained its highest concentration in the forest canopy, 50–60 ft. above ground, where it was taken biting even in very dry weather. It was definitely crepuscular, 42 per cent. of the total catch being taken in the hour following sunset when atmospheric humidity was high, temperature was fairly high and the light was fading. Optimum conditions were provided by a still, warm evening after a sunny afternoon. This species, which is an experimental vector of yellow fever [**17** 213], may be of major importance in the transmission of the disease among monkeys. Evidence in support of this view is discussed. In spite of the prevalence, wide distribution and arboreal habits of *Aëdes apicoargenteus*, it is considered of doubtful importance in relation to yellow fever in view of the negative results obtained with it by Bauer in transmission experiments [**16** 235–236]. The one really abundant Bwamba species of *Eretmapodites* (*E. chrysogaster*, Graham) was taken at ground level only. No attempt was made to distinguish the numerous small species of *Culex*, but members of this genus were common at all levels and their biting-activity showed a marked peak in the hours immediately after sunset.

Observations on the microclimate at various levels indicate that in the forest area concerned there are two main microclimatic strata. The lower stratum is very equable, cool and humid. The upper, which includes most of the understorey and canopy foliage, is warmer and drier, shows a much greater daily range and has many points in common with the climate in the open. During wet weather and by night, the differences between these strata are much reduced. The relationship of the microclimate to mosquito behaviour is briefly discussed.

BASDEN (E. B.). **Breeding the House-fly (*Musca domestica*, L.) in the Laboratory. I. Introduction and Technique.**—*Bull. ent. Res.* **37** pt. 3 pp. 381–387, 1 pl., 17 refs. London, 1947.

Descriptions are given of the breeding room, oviposition cages and culture containers and the rearing technique in use at the Pest Infestation Laboratory of the Department of Scientific and Industrial Research for breeding *Musca domestica*, L., of which 2,500 adults per day have been needed since December 1942. The procedure is based on the large-group Peet-Grady technique [*cf. R.A.E.*, B **26** 245], but there are several modifications. An oviposition cage is stocked each week with 80 male and 80 female flies not more than one day old. Sufficient eggs are obtained each day from this number of flies to produce an average of 4,000 puparia. The jar in which the eggs are laid is removed daily, and after a further 24 hours, the contents are mixed with an adequate amount of freshly prepared food. The rearing medium, which is adapted from that of Richardson [**20** 261], and the formula eventually adopted in the Peet-Grady procedure, consists of 4 lb. middlings, 2 lb. grass meal, 6,000 cc. tap water, 60 gm. dry malt extract and 45 gm. dried yeast. The food is immediately transferred to 12 culture jars, which are left undisturbed until the puparia are removed six days later. Reference is made to various methods of collecting puparia. Flotation was the one finally adopted and this is described. To obtain flies for tests, clean puparia that do not differ in age by more than two days are put into sleeve cages in which the adults emerge.

DAVID (W. A. L.) & BRACEY (P.). **Factors influencing the Interaction of insecticidal Mists and flying Insects. Part IV. Some Experiments with Adjuvants.**—*Bull. ent. Res.* **37** pt. 3 pp. 393–398, 2 figs., 9 refs. London, 1947.

In experiments on the effect of spray mists on *Aëdes aegypti*, L. [*cf. R.A.E.*, B **34** 201, etc.], the rate of knock-down was always decreased when sesamin, sesame oil or isobutylundecyleneamide was added to a pyrethrum spray [*cf.* **33** 87]. As the decrease was as great with 0·2 per cent. w/v sesamin as with 5 per cent. sesame oil, it seems improbable that the delay can be attributed to changes in the concentration or viscosity of the spray droplets [*cf.* **33** 87–88], and as the inclusion of lubricating oil in a spray drawn past chloroformed mosquitos led to an increase in the percentage kill, due to its effect on the particle size of the mist, it is apparent that adjuvant action is independent of a prolongation of the period of flight [**33** 87]. It was shown by the successive application to chloroformed mosquitos of a spray containing the adjuvant and one containing pyrethrins that adjuvant action was still apparent under these circumstances with sesamin and isobutylundecyleneamide but not with lubricating oil. It is therefore concluded that activators cause an increase in kill not attributable to any effect they may have on the particle size of the spray mist or the behaviour of the insects leading to an increase in the dose accumulated. No effect of adjuvants was apparent with DDT. The mode of action remains unexplained.

SYMES (C. B.) & HADAWAY (A. B.). **Initial Experiments in the Use of DDT against Mosquitos in British Guiana.**—*Bull. ent. Res.* **37** pt. 3 pp. 399–430, 1 pl., 3 figs., 2 refs. London, 1947.

Detailed accounts are given of simple preliminary trials made from 27th January to 20th April 1945, on the effect on mosquitos of single applications of DDT to the internal surfaces of dwellings in British Guiana, where the low-lying ground irrigated for rice cultivation and frequently flood fallowed for sugar-cane allows of the development of very large numbers of mosquitos. The following is mainly based on the authors' summary. The solution used in the first two trials was 4·6 per cent. DDT (containing 72 per cent. of the para para isomer) in kerosene applied at the rate of about 2 quarts per 1,000 sq. ft. (about 106 mg. crude DDT per sq. ft.). The apparent reduction in the numbers of *Anopheles darlingi*, Root, in the treated houses exceeded 99·7 per cent. over eight weeks on one estate and over six weeks on another. At the dosage applied, DDT seemed less effective against *Culex fatigans*, Wied. In a third trial with a small variety of simple formulae, promising results were obtained against *A. darlingi* with 6 per cent. DDT in emulsified xylene and 2½ per cent. DDT as a solution in oils, but mosquito catches over a short period suggest that mud walls, thatch and whitewash may interfere to some extent with the action of DDT. The cost of application is discussed.

A trial of the Hochberg-LaMer aerosol generator is described by K. C. Hodges & J. Rowell. In this device, an aqueous emulsion of an oil in which the insecticide has been dissolved is pumped under pressure through flow-control apparatus into a heater coil, where the water but not the oil is vaporised. As the water vapour and oil are discharged, the oil is broken up into particles of 1–10 microns radius. With about 7 per cent. DDT in the emulsion, kills of captive larvae and adults of *A. darlingi* were recorded over a range of about 8,000 ft. from the generator, and a considerable reduction of mosquito adults, mostly *C. fatigans*, occurred in bedrooms in the village through which the insecticide " fog " drifted.

Initial studies were made of the entry of mosquitos into a specially built hut treated with 5 per cent. DDT in kerosene at 2 quarts per 1,000 sq ft. and their behaviour in it. Mosquitos entered readily. They attacked freely during peak

periods of entry, at dusk and dawn, but not so frequently at other times as they did in an untreated hut. It is assumed that most, if not all, of those that attacked had not made contact with treated surfaces. Mosquitos that had made such contact soon became affected, and many of them apparently escaped through open doors or windows. All mosquitos taken from the treated walls of the hut died within 14 hours.

The equipment used in these experiments is not considered suitable for the application of sprays intended to leave a toxic residue, and it is emphasised that the trials are only in their early stages. A long series of observations must be made before definite conclusions can be drawn as to the real effect of the applications.

It was observed in a field cage that in vegetation adults of *A. darlingi* rested on the ground or very near it and could be induced to leave this position only with very great disturbance. *A. aquasalis*, Curry, was found only occasionally in houses, though larvae were frequent and considerable numbers of adults were taken in an animal-baited trap.

LEPAGE (H. S.), GIANNOTTI (O.) & PEREIRA (H. F.). **Técnica para o ensáio de inseticidas residuais.** [A Technique for testing residual Insecticides.]—*Biológico* **11** no. 12 pp. 320–325, 3 figs., 1 ref. São Paulo, 1945.

An account is given of laboratory experiments to compare the toxicity of deposits of DDT and 666 [benzene hexachloride] to house-flies [*Musca domestica*, L.]. Apparatus was devised consisting of a square wooden frame, having slots in two sides so that two glass plates could be slid into place, forming a flat box about ¼ inch deep inside. The slots were so arranged that the plates just cleared the other sides without touching them, thus permitting the free passage of air. Flies were introduced through a hole in a piece of cardboard substituted for one of the plates. In the first tests, solutions of DDT or 666 in acetone (1 : 400) were applied to glass plates to give a residue of 0·019 mg. per sq. cm., and, as soon as they had dried, the plates were slid into frames containing known numbers of flies. They were replaced with clean ones after 1, 2, 4, or 8 minutes, and records were kept of the subsequent time required for a knock-down of all the flies in each frame. The average periods required after 1, 2, 4, and 8 minutes' exposure were 166·5, 62, 25 and 16·5 minutes for DDT, and 40, 30, 16, and 10 minutes for 666. The symptoms were similar for both insecticides, although more violent with 666.

In the second series, the treated plates were exposed for various periods to the air in the laboratory at 25–29°C. [77–84·2°F.] or to direct sunlight at 40–45°C. [104–113°F.] before being placed in the frames, where they were left for 4 or 8 minutes. The periods required by DDT for complete knock-down after 24, 48 and 116 hours' exposure to air were 15, 17 and 16 minutes for 4 minutes' exposure to the insecticide and 10, 8 and 11 minutes for 8 minutes' exposure, and the corresponding periods for 666 were 40, 85 and 123 and 48, 70 and 90 minutes. After exposure to sunlight for 4 and 8 hours, the periods required for DDT were 17 and 10 minutes for 4 minutes' exposure to the insecticide and 6 and 5 minutes for 8 minutes' exposure. Contact for 4 and 8 minutes with 666 exposed to the sun for 4 hours resulted in complete knock-down in 290 and 150 minutes, respectively, but when the insecticide had been exposed to the sun for 8 hours, it did not produce complete knock-down in 5 hours.

Entomological Investigations.—*19th Rep. Coun. sci. industr. Res. Aust. 1944–45* pp. 19–30. Canberra, 1945. **Animal Health Investigations.**—*T.c.* pp. 31–39.

This report deals with investigations in Australia in the year ending 30th June 1945. In an experiment with a sheep dip of arsenic and sulphur, the sheep dipped first retained as much soluble and insoluble arsenic as those dipped last,

when suint would have increased the wetting power of the dip [*cf. R.A.E.*, B **29** 101 ; **30** 81]. Addition of soap as a wetting agent did not affect the quantity of arsenic retained. The base of the wool contained less soluble and insoluble arsenic than the tip, and the neck, midside and belly tended to retain less arsenic than other parts. The amounts of arsenic retained after 48 days in the fleece of two sheep dipped in sodium arsenite and two dipped in a solution of arsenic and phenol were not significantly different ; samples from two sheep dipped in arsenic and sulphur gave somewhat variable results. This suggests that where arsenic is effective, as it is for the control of the body louse, *Damalinia* (*Bovicola*) *ovis*, L., there is no advantage in the use of complex dips. A solution of sodium arsenite (1 : 10,000) completely eradicated lice from carefully dipped sheep. All adult keds [*Melophagus ovinus*, L.] were killed when 43 infested sheep were dipped in a suspension of 8 oz. timbo root (4·6 per cent. rotenone) per 100 gals., but a few emerged from pupae and survived, and three sheep carried a few keds ten weeks after dipping. Such an infestation is not easily detected, but a heavy population may be built up from it during the year. Many lice survived a similar dip. An emulsion of DDT (1 : 5,000) killed all adult keds in a few hours, and over four weeks elapsed before it was possible to re-establish an infestation on the dipped sheep. Emerging adults would be killed by the toxic residue. Adult lice were all killed by DDT at 1 : 2,500 but some survived a dilution of 1 : 5,000.

It was found difficult to obtain normal egg production of *D. ovis* under artificial conditions. The louse could live on material scraped from a sheep's skin, but the life-cycle was accelerated by the addition of yeast. The eggs require a temperature of about 37°C. [98·6°F.]. They did not hatch at 32°C. [89·6°F.], or at 37° if previously kept at 27°C. [80·6°F.] for two days. The egg stage lasted 9–11 days, and the life-cycle from egg to egg 38–50 days. The lice are apparently much less susceptible to changes of humidity than to changes of temperature. A relative humidity of 50 or 70 per cent. is satisfactory ; 90 per cent. is unfavourable but not necessarily lethal. The heaviest concentration of lice on the sheep is found along the mid-line of the back, with the largest numbers usually in the region of the withers.

Lesions on the legs of sheep on the black earths of the central highlands of Queensland were found to be caused by a previously unknown mite, *Trombicula sarcina*, Womersley. Recovery is spontaneous and preventive measures would be uneconomic except in special cases. The same mite causes acute irritation in man. Its natural host is the grey kangaroo (*Macropus major*).

The use of the modified Mules' operation to reduce the susceptibility of sheep to blowfly infestation [**32** 142 ; **33** 50] is increasing. A high incidence of strike in the operation wounds of a batch of lambs treated at marking time was found to be associated with the relatively long wool on the breech, which led to matting and infection of the wound. The value of the medium-long tail with the stump $\frac{1}{4}$–$\frac{1}{2}$ in. below the tip of the vulva was confirmed [*cf.* **32** 142]. Long tails, docked at about 4 ins., gave similar reduction of strike, but made it more dificult to crutch or shear. Three trials of dressings for use at lamb marking were carried out when flies were active at marking time. In the first, B.T.B. dressing [a mixture of boric acid, tar oil and bentonite (*cf.* **33** 51)] reduced strike from 18 to 3 per cent. Percentage infestations in the second on controls and on lambs treated with a commercial tar oil dressing, B.T.B., a copper-sulphate solution, and B.T.B. and citronella soap emulsion were 39, 44, 25, 13 and 11, respectively. In the third, the percentage infestations were 14 for no treatment, 4·5 for copper sulphate, 0·7 for a mixture of boric acid, citronella and bentonite and 9 for B.T.B. in one group of lambs, and 19 for no treatment, 10 for copper sulphate and 2 for the new mixture in a second. Observations on selective breeding [*cf.* **33** 178] justify the hypothesis that " wrinkling " and " plain body " are paired characters, the inheritance of which is Mendelian and polygenic. Plain body is dominant.

Fully grown larvae of *Lucilia cuprina*, Wied., were not affected by crawling in DDT crystals or inert dusts containing DDT or by immersion for 10 minutes in kerosene solutions of DDT or suspensions produced by adding acetone solutions of DDT to water. Adult blowflies are killed by resting on surfaces treated with DDT. Contact for a few seconds with a surface treated with DDT at 50 mg. per sq. ft. [*cf.* **34** 133] was enough to kill house-flies [*Musca domestica*, L.]. Exposure of adults of *Ctenocephalides felis*, Bch., for one minute or longer to filter paper or calico impregnated with DDT at 50 mg. per sq. ft. or more gave complete mortality of the fleas in 24 hours, but kill was lower if the exposure time or amount of DDT per sq. ft. was reduced. When the fleas were exposed for 30 minutes in aerated jars to calico impregnated with one of four chemicals, Lethane 384 [50 per cent. n-butyl carbitol thiocyanate] paralysed the fleas most rapidly and gave complete kill of those exposed 3½ hours or less after impregnation, but Thanite [a terpene thiocyano ester], paradichlorbenzene and naphthalene were not effective under the same conditions. Hatching of eggs of *C. felis* was not impaired by the presence of DDT in the sand containing them, but newly hatched larvae were paralysed rapidly and killed in 24 hours by as little as 0·01 per cent. by weight DDT in the medium, which was also lethal to fully grown larvae. Treatment with 4 per cent. DDT in kerosene cleared quarters of an infestation of *Cimex lectularius*, L. A spray containing 0·5 per cent. DDT and 0·03 per cent. pyrethrins caused little mortality when applied liberally against *Blattella germanica*, L., in a natural infestation, but a dust of pyrophyllite impregnated with 10 per cent. DDT caused high mortality.

When large numbers of larvae of the cattle tick [*Boophilus annulatus microplus*, Can.] are placed on an animal, relatively few actually become attached. Some 95 per cent. of these attach themselves immediately, and the remainder within about three days. The ticks are most susceptible to arsenical dips in the young larval, young nymphal and young adult stages [but *cf.* **33** 152]. Detailed study of the life-cycle showed that by dipping three times at intervals of three days and repeating this after a further 15 days, every tick on an animal would be exposed in a vulnerable stage to the dip. In field trials of this procedure, normally infested animals were completely freed of infestation, and less than 300 ticks survived out of 2,000,000 of a resistant strain that were placed on two animals. Brief results are given of tests that provided additional evidence that the difficulty of controlling the cattle tick in many areas is due to the presence of arsenic-resistant strains there [*cf.* **33** 152]. In laboratory experiments, arsenical dip of standard strength was buffered to pH of 2, 4, 6, 8, 10 or 12 and mature ticks of a resistant strain were dipped for one minute. Almost complete mortality was obtained at both extremes, but none in the solutions having a pH of 8. As the average pH of dipping fluids used under practical conditions was found to be 8·4, this result indicates that greatly improved control might be obtained by altering the pH of dips. Arsenical cattle dips may lose effectiveness when not in use through oxidation of trivalent arsenic to the pentavalent level [*cf.* **32** 69]. A bacterium closely resembling the South African *Bacterium arsenoxydans* [**8** 6, 204] was isolated from dipping fluid from Brisbane during the year. Under laboratory conditions, dipping fluid contaminated with faecal matter became completely oxidised in about a month, but oxidation was prevented by covering the surface with a layer of oil or a floating solid. Contaminated dip quickly oxidised in vats in the field, but oxidation was prevented for three months in one test by floating a raft on the dip in a previously used vat. All parasitic stages of the cattle tick could be killed with one application of an emulsion containing 2 per cent. DDT, which also prevented successful reinfestation for about 12 days. Lower concentrations decreased the protective period and increased the chances of survival. Field observations suggest that spraying with a 2 per cent. emulsion every 30 days would eradicate the tick.

The trap tested in 1943–44 against *Siphona* (*Lyperosia*) *exigua*, de Meij. [**32** 152; *cf.* also **26** 248] was installed in farms and gave very satisfactory control on milking herds. By dusting the narrow, weighted strips of canvas with coloured powders and observing the position of the marks on the cattle after they had passed through the trap, it was found that these strips did not fulfil their purpose of swinging under the belly and around the legs of the animal, and their use therefore appears unnecessary. As the gauze trapping boxes of the standard trap are complicated in construction, a trap with sides and a peaked roof of glass, sprayed on the inside with DDT in kerosene, was tested as a substitute. It was not designed to retain the flies but merely to bring them into contact with the DDT when they were following the cattle past the curtains. The results were at least as satisfactory as those obtained with the standard trap. Within about a week, the infestation of a herd was reduced from about 200–300 flies per cow with 5,000–10,000 on the bull to a mean of less than 12 per cow with less than 100 per bull. The DDT on the glass appeared to remain completely effective for about two months, after which there were indications that re-spraying was necessary. The glass would therefore have to be treated only twice in the normal fly-season (December to April), and great economy of DDT would be effected by using it in this way instead of spraying the animals. Pieces of hide sprayed with solutions or emulsions of DDT after being removed from freshly slaughtered cattle retained enough after exposure to the weather for five months to kill flies caged on them, whereas similar concentrations of DDT have almost completely disappeared from living cattle after a fortnight. Licking and rubbing may account for some of the loss, but probably not all of it. An emulsion of DDT in solvent naphtha with a proprietary wetting agent made a highly satisfactory cattle spray. A continuation of previous experiments [**33** 152] showed that spraying an area of 12 ins. by 18 ins. on either side of the shoulders of each animal gave adequate control of the flies. In practical experiments, DDT sprays applied with ordinary atomisers to cows during milking killed all flies enveloped in the mist and left a deposit on the hide that remained effective after the solvent had dried. A consignment of *Hister* (*Platylister*) *chinensis*, Quensel, from Fiji was liberated in the Cairns district for the control of *S. exigua*.

GILL (D. A.). **Microphotography as an Aid to the Identification of Trombiculine Larvae.**—*J. Coun. sci. industr. Res. Aust.* **18** no. 4 pp. 298–300, 6 pls., 3 refs. Melbourne, 1945.

The following is based on the author's summary. The difficulty of identifying the larvae of somewhat similar species of Trombiculids (including Leeuwenhoekiids) from descriptions, drawings, and measurement is discussed. The use of microphotography of the whole mite and of its dorsal scutum is recommended as an additional aid. Microphotographs of six species are reproduced in plates, and the photographic technique used to obtain them is given in detail. It is considered that a complete series of such photographs, covering all the known species of Trombiculid mites, would be of great assistance.

[SERDYUKOVA (G. V.).] **Сердюкова (Г. В.). Instances of the local Mass Increase of the Ticks** *Hyalomma anatolicum anatolicum* **Koch in Tadzhikistan and their Causes.** [*In Russian.*]—*Izv. tadzhik. Fil. Akad. Nauk SSSR* no. 6 pp. 60–63, 2 refs. Stalinabad, 1946.

Observations in yards in which cattle are kept in the Hissar Valley (semi-desert zone of Tadzhikistan) showed that the adults of *Hyalomma anatolicum*, Koch, which is a three-host tick and usually infests cattle, occurred with equal

frequency on animals of all ages, whereas most of the larvae and nymphs were found on calves. The ticks fed only during the warm period of the year. During July–August, the females began to oviposit 7–9 days after having dropped from the host, the oviposition period lasted 15–19 days, and the eggs hatched in 23–26 days. Larvae fed for 2–4 days and moulted after a further 6–12 days, and nymphs fed for 4½–6 days and moulted after a further 12–20 days. In winter, unfed males and fed and unfed females entered a diapause, and unfed larvae were able to survive in unheated quarters. The ticks detached themselves from their hosts at night, most of the larvae and nymphs doing so between 9 and 11 p.m. Some of a number of larvae and nymphs that were placed on a calf in the morning became fully engorged during the day, but they remained on the calf till darkness set in. This behaviour is probably an adaptation to local climatic conditions, since it protects the ticks from exposure to the direct rays of the sun, which are fatal to them. They are apparently inactive during the hot part of the day, and attach themselves to their hosts at night, as has been recorded for other species of *Hyalomma* under desert conditions. In observations in an isolated plot, only slightly over 5 per cent. of a counted number of unfed examples of *H. anatolicum* attached themselves to calves between 12.30 and 5.30 p.m.

Infestation of village cattle was found to be severe. These animals were driven out to graze in pastures during the day, but were kept at night in open yards surrounded by loess walls. The yards contained enclosures for the calves, and other fittings made of wood, and ticks in various stages, both engorged and unfed, were found in cracks in and beneath these and in other sheltered sites associated with them. No ticks occurred under cakes of dung plastered on the loess walls. These conditions were apparently favourable to the development of the ticks and maintained the infestation. When almost all the permanent wooden structures in one of the yards were removed in the autumn, the soil consolidated and a portable enclosure for calves erected in a different place in the following year, only about 50 engorged nymphs could be collected each morning in the enclosure during July and August, as compared with up to 1,000 in the preceding year. It is therefore recommended that wooden structures in the yards should be portable, and that they should be cleaned and moved to different places and the soil on the old sites dug over once a month from the time ticks appear on the cattle in spring.

[Lototzkiĭ (B. V.) & Pokrovskiĭ (S. A.).] **Лотоцкий (Б. В.) и Покровский (С. А.). An Experiment in the Organisation of a minimum Complex of Measures against Haemosporidiasis in northern Tadzhikistan.** [*In Russian.*] —*Izv. tadzhik. Fil. Akad. Nauk SSSR* no. 6 pp. 64–74, 22 refs. Stalinabad, 1946.

Investigations on the control of ticks that transmit various forms of piroplasmosis of cattle in Tadzhikistan, where these diseases cause high mortality among newly introduced animals, were carried out in a village near Ferghana from December 1939 to August 1941. The cattle in another village, where conditions were similar, served as controls. The ticks concerned were *Hyalomma detritum*, Schulze, and *H. anatolicum*, Koch, which transmit *Theileria*, and *Boophilus calcaratus*, Bir., which transmits *Piroplasma* [*cf. R.A.E.*, B **34** 117].

Observations on the behaviour of the ticks showed that larvae or nymphs of *H. detritum* occur on the cattle between September and mid-April. The authors distinguish four periods of infestation, however, in September–October, November–December, December–January and February–April. The larvae moult on their hosts, and nymphs that dropped in any of these periods did not moult to the adult stage until mid-May. Infestation by adults began in April, reached a peak towards the end of May or the beginning of June, and ceased

towards the end of September. *H. anatolicum*, which the authors consider to be a two-host tick [*cf.* **32** 86], infested cattle from February to the end of November. Larvae and nymphs were present in July, August and September and, like the adults, were most numerous in the first ten days of August. *B. calcaratus* occurred on cattle from mid-February to the end of November and there were three waves of infestation, of which the first lasted from mid-April till about June, the second began in July and reached its peak in August, and the third overlapped the second and lasted till mid-October. Larvae, nymphs and adults usually occurred simultaneously.

In an attempt to control *H. detritum*, the animals were wiped down with a mixture of equal parts of kerosene and crude cottonseed oil four times during the winter of 1939–40, the dates selected being 31st December, 25th January, 23rd February and 13th March, and with a 0·2 per cent. solution of sodium arsenite at weekly intervals during the summer, but the examination of the cattle in the summer showed no appreciable reduction in infestation as compared with the controls. This was attributed to faulty timing of the winter treatments. Cottonseed oil was not available during the following winter, and the animals were treated twice, on 15th and 25th January with desinsectalin [*cf.* **34** 119], after which applications of sodium arsenite were made every six days, beginning on 5th February. The results were still unsatisfactory, and it was concluded that the materials used were not effective.

In the experiments against *B. calcaratus*, the cattle were treated with a 0·18–0·2 per cent. solution of sodium arsenite at intervals of six days from 6th April to 11th October 1940 and again from 5th February to 1st August 1941. The liquid was brushed over the upper parts of the body and sprayed over the lower parts. The results were satisfactory, the numbers of this tick taken per animal averaging 19·2 in June–November 1940, as compared with 647·7 in the controls, and 89·8, including an average of 20·8 larvae and nymphs, between 1st January and 1st August 1941, as compared with 426·6, with 194·1 larvae and nymphs, for the same period in the preceding year. This treatment also proved effective against *H. anatolicum* and reduced the average number of this tick per animal to 34·4, including 11·7 larvae and nymphs, as compared with 166·9, with 77·3 larvae and nymphs, in the controls, between April and November 1940, and the average number of larvae and nymphs to 0·7, as compared with 73·8 in the controls, from 1st January to 1st August 1941. These reductions in infestation were partly due to removal of the engorged ticks every few days, cleaning of the cattle yards and the transfer of the animals to uninfested winter quarters.

[Vorob'eva (A. N.) & Pokrovskiĭ (S. A.).] **Воробьева (А. Н.) и Покровский (С. А.). Test of lubricating waste Oil as a Means of Controlling Ticks.** [*In Russian.*]—*Izv. tadzhik. Fil. Akad. Nauk SSSR* no. 6 pp. 90–91. Stalinabad, 1946.

In further experiments against ticks on cattle in Tadzhikistan [*cf.* preceding abstract], three of six cows that were about equally infested with *Hyalomma detritum*, Schulze, were brushed with used lubricating oil in May 1941. After 24 hours, 203 ticks, all living, were found on the untreated cows and 60 living and 47 dead ones on the treated animals. The presence of so many living ticks on the treated cows was probably due to reinfestation, but the fact that they included five fully and ten partly engorged females showed that some had survived the treatment. In another test in which the predominant tick was *H. anatolicum*, Koch, four cows were freed from ticks by hand and two of them were treated with the oil. The numbers of ticks found 24 hours later were 72 on the treated animals and 118 on the others, so that the oil had little repellent effect.

[Blagoveshchenskiĭ (D. I.) & Serdyukova (G. V.).] **Благовещенский (Д. И.) и Сердюкова (Г. В.). The Action of chemical Substances on Pasture Ticks.** [*In Russian.*]—*Izv. tadzhik. Fil. Akad. Nauk SSSR* no. 6 pp. 75–89, 7 refs. Stalinabad, 1946.

An account is given of laboratory and field experiments in Tadzhikistan in 1943 in which various substances were tested as repellents for Ixodid ticks that infest cattle. In the laboratory, unfed males and females of *Hyalomma anatolicum anatolicum*, Koch, *H. a. excavatum*, Koch, and *Rhipicephalus turanicus*, Pomerantzev, were confined in small clay squares from which they could escape only by crossing barriers of the substances under test, or in the case of a liquid, strips of impregnated fabric. The results are given in tables and showed that of the 26 substances tested, the only ones that proved more or less effective were liquid carbolic acid, lysol, naphtha-lysol, creolin, tar, mint oil, turpentine, aniseed oil, clove oil, ethyl acetoacetate, coriander oil and a pinene obtained from juniper oil [*cf. R.A.E.*, B **33** 15]. Pyrethrum powder was not repellent, but killed ticks that came into contact with it. Of diluted preparations commonly applied in practice, the most effective were 10–30 per cent. carbolic acid, lysol, naphtha-lysol or creolin in water. In experiments with *R. turanicus* outdoors, the effectiveness of all substances was reduced.

In tests in which calves were treated with lysol, creolin or naphtha-lysol at concentrations of 5 per cent. in water or vaseline ointment, and confined for up to four hours on plots in which 200–400 unfed adults of *H. a. anatolicum* were released, naphtha-lysol was the only material to give promising results. It apparently repelled and killed the ticks, and was more effective in the ointment than in water. The ticks crawled on to calves dusted with pyrethrum, but of 181 that were collected from them, 111 were moribund. Evidence was obtained in additional experiments with females of *H. marginatum*, Koch, and *H. a. anatolicum* that pyrethrum is toxic to ticks that have not attached themselves to their hosts and to those that have just begun to feed, but has little effect on females that are partly engorged, even after a second application.

[Sosnina (E. F.).] **Соснина (Е. Ф.). Test of certain Disinfectants for the Control of the Tick, *Ornithodorus papillipes* Bir.** [*In Russian.*]—*Izv. tadzhik. Fil. Akad. Nauk SSSR* no. 6 pp. 92–100, 4 refs. Stalinabad, 1946.

In the first of the experiments described, which were carried out in Tadzhikistan in 1943, examples of *Ornithodoros tholozani*, Lab. & Mégn. (*papillipes*, Bir.) collected in animal quarters were placed in glass jars and sprayed or dusted with substances under test. Spraying with a pinene fraction of juniper oil, medium light tar oil and anabašine sulphate killed all the ticks in 5 minutes, while kerosene and a 10 per cent. solution of K soap [a soap containing 50 per cent. dixanthogen] both did so in 15 minutes. Of the powders, desinsectalin [*cf. R.A.E.*, B **34** 119] gave complete mortality in rather more than 24 hours, whereas SK dust [*cf.* **31** 226, 228] and pyrethrum powder gave only 80 and 36·7 per cent. mortality, respectively, in 48 hours.

When filter papers were impregnated with the liquids under test and stuck round the inside of the jars at about an inch from the bottom or the dry substances were suspended in the jars in small muslin bags of double thickness so that there was no direct contact, kerosene, tar oil and the pinene fraction of juniper oil gave complete mortality in 2, 8 and 48 hours, respectively, and desinsectalin, SK dust, K soap, SK liquid, anabasine sulphate and pyrethrum powder 95, 73·3, 70, 60, 20 and 3·3 per cent. mortality, respectively, in 48 hours.

In tests of repellent action, powders or strips of fabric impregnated with liquids were distributed round flat celluloid rings 10 ins. in diameter nailed to boards covered with clay, and ticks were liberated in the centre of each ring. The dusts tested were desinsectalin, SK and pyrethrum powder, and all were

ineffective in preventing the ticks from crossing the barrier; the percentages that crossed impregnated fabric within an hour averaged 50 for tar oil, 63·3 for anabasine sulphate, 73·3 for SK fluid, 80 for kerosene and 83·4 for the pinene fraction of juniper oil, and nearly all the ticks that remained inside the rings were dead.

To test the probable effect of liquids on ticks in a clay wall, small muslin bags containing partly engorged nymphs were inserted into holes in clay disks about 3 ins. thick and the holes stopped with wooden plugs. The disks were then impregnated with the liquids under test and placed in holes in the ground 10 ins. deep where they were shaded with twigs and dry grass. Different lots of ticks were examined on the six succeeding days and the results showed that γ-pinene of juniper oil killed all the ticks in two days, and kerosene and a 25 per cent. emulsion of tar oil nearly all in six days; 10 per cent. SK fluid or K soap in water and a 25 per cent. solution of anabasine sulphate had no effect. These disks were also used to test the effect on ticks in walls of incorporating toxicants in whitewash or in clay used to stop cracks, but no success was obtained.

In experiments on the treatment of a vertical surface, the ticks were placed in muslin bags in holes about $1\frac{3}{4}$ ins. and 2 ins. behind the front surfaces of blocks of clay and these surfaces brushed several times in two hours with γ-pinene of juniper oil, kerosene or a 25 per cent. emulsion of tar oil. The blocks were exposed to rainy weather in a draughty building with broken windows, and different lots of ticks examined daily. After six days, most of the ticks in the holes nearer to the treated surfaces were dead and the survivors moved only with difficulty, but mortality in the holes further from the surface was slight.

[Pisarenko (F. S.) & Sosnina (E. F.).] **Писаренко (Ф. С.) и Соснина (Е. Ф.). Individual Protection of Man from the Attacks of the Tick** *Ornithodorus papillipes* **Bir.—the Vector of the causal Agent of Tick-borne Relapsing Fever.** [*In Russian.*]—*Izv. tadzhik. Fil. Akad. Nauk SSSR* no. 6 pp. 101–108, 8 refs. Stalinabad, 1946.

With a view to finding a simple means of protecting troops posted along the frontier in Tadzhikistan from attack by *Ornithodoros tholozani*, Lab. & Mégn. (*papillipes*, Bir.) [*cf. R.A.E.*, B **33** 198, 199], experiments with repellents were carried out in August–September 1944. Those tested were tar, lysol, naphtha-lysol, kerosene, turpentine and creolin. None of these was effective when applied to strips of muslin of double thickness and 6 ins. wide that were laid flat on a floor of clay, and 5 per cent. lysol in water was ineffective when applied to the edges of a large cotton sheet on the ground in the centre of which two men slept. In further tests, it was found that a strip of gauze 6 in. wide pegged in an upright position along the ground formed a considerable obstacle to the ticks, whether or not it was impregnated with a repellent, though many crawled under it where the ground was uneven; and few or no ticks passed over a barrier consisting of a horizontal and a vertical strip sewn together along the edge and impregnated with kerosene, turpentine, 25 per cent. creolin or 10 per cent. lysol or naphtha-lysol, though a few crawled under it.

It was thought, therefore, that complete protection might be obtained by fixing a vertical strip of treated fabric round the edge of a groundsheet, and accordingly strips of material 8 ins. wide were sewn along the four sides of such sheets at a distance of about 4 ins. from the edge and held in an upright position by means of tapes and pegs. The upright strip of material and the outer margin of each sheet were moistened with a repellent by means of a piece of cotton-wool, and after these had dried, the sheets were folded and later put into use. They proved very effective, and the best repellents were a mixture of 5 gm. sodium hydroxide, 200 gm. tar and 750 cc. water, boiled together for

an hour, and one prepared by dissolving 50 gm. soft soap in 850 cc. hot water, adding 100 gm. lysol or naphtha-lysol, bringing the whole to the boil and applying the liquid while still warm. Sheets treated with these mixtures, respectively, were used for three and seven consecutive nights in huts heavily infested with ticks and afforded complete protection from them, while other sleepers in the huts were attacked.

TORRES CAÑAMARES (F.). **Culicidos de la provincia de Cuenca (Dip. Cul.).** [Mosquitos of the Province of Cuenca.]—*Rev. Sanid. Hig. públ.* **19** repr. 15 pp., 2 pls., 6 refs. Madrid, 1945.

A list is given of 24 species of mosquitos taken by the author in the Province of Cuenca, Spain, up to the year 1945, together with notes on their distribution and breeding places. The Anophelines comprise *Anopheles maculipennis* var. *atroparvus*, van Thiel, *A. marteri*, Sen. & Prun., *A. plumbeus*, Steph., *A. hispaniola*, Theo., and *A. claviger*, Mg., and *A. claviger* var. *pollutus*, Torres Cañamares [*cf. R.A.E.*, B **35** 44].

DORIER (A.). **Sur la capsule céphalique des larves de Simulies (Dipt. Nématocères).**—*Bull. Soc. ent. Fr.* [**50**] no. 8 pp. 108–109, 6 figs., 2 refs. Paris [1946].

Puri, in a paper already noticed [*R.A.E.*, B **14** 5], mentioned differences in the extent of the lightly chitinised area in the ventral wall of the head-capsule of the larvae of two species of *Simulium*. Examining this area in six species, the author found distinct differences in its shape and size, on the basis of which the species fell into four groups. The characters of the area in these groups are given, with brief descriptions and figures of its shape in each species. It is thought that the characters may have systematic value.

TAYLOR (E. L.). **Acaricidal Property of a new Insecticide, Hexachlorobenzene.**—*Nature* **155** no. 3935 pp. 393–394. London, 1945.

The author briefly refers to the discovery of the insecticidal properties of benzene hexachloride (hexachlorcyclohexane) [*R.A.E.*, B **33** 130–133], which he calls hexachlorobenzene, and states that recent experiments at the Veterinary Laboratory of the Ministry of Agriculture showed it to be at least as effective as DDT against lice on guineapigs and highly toxic to fresh-water Crustacea. In comparative tests against mange mites (*Notoëdres*) on heavily infested rats, in which 1 per cent. solutions of the compounds in liquid paraffin or olive oil were applied only to the affected (hairless) parts and these were not washed with soap and water before treatment, benzene hexachloride was much more effective than benzyl benzoate or tetraethylthiuram-monosulphide, and DDT showed very little effect. A 2 per cent. solution of DDT caused the death of some of the test rats. Since benzene hexachloride gave complete control under the relatively different conditions of the test and no living mites were found in the old lesions, it is considered that it will prove of great value in the treatment of sarcoptic and psoroptic mange in animals, including sheep scab [*Psoroptes ovis*, Hering], and of scabies [*Sarcoptes scabiei*, Deg.] in man.

CRAGG (J. B.). **"D.D.T." as a Sheep Blowfly Dip.**—*Nature* **155** no. 3935 p. 394, 1 ref. London, 1945.

As laboratory tests showed that adults of *Lucilia sericata*, Mg., were killed by contact with sheep wool dipped in an emulsion containing 0·5 per cent. DDT, field tests were carried out in North Wales in 1944 to ascertain whether the toxic effect of DDT emulsion (M 21), used as a dip, was sufficiently rapid to prevent

gravid females of this blowfly from ovipositing on sheep. In the first experiment, in which the concentration of DDT in the dip fell from 0·3786 to 0·3264 per cent. in the course of the dipping, 81 sheep were dipped on 8th August and they remained free from strike throughout the 42 days of observation. It was not possible to have a control group grazing with the test flock, but several severe infestations by larvae were reported on neighbouring flocks, and chemotropic experiments on the same farm showed that conditions for strike were better during this period than in the four weeks before dipping, when ten strikes were recorded in the test flock. In the second experiment, each of five groups grazing in different parts of one farm was divided equally as regards breed, age and sex, and one half was dipped in DDT emulsion and the other in a commercial arsenical dip on 29th August. In all, 215 sheep were treated with each material, and the concentration of DDT fell from 0·454 to 0·2388 in the course of dipping. During the 44 days after dipping, three strikes, one a restrike, occurred on the sheep treated with DDT, and 21, with no restrikes, on the others. The first strikes occurred 24 and 6 days after dipping, respectively.

In further tests, nine of 13 adults of *L. sericata* caught on sheep that had been dipped in DDT three weeks before, but only two of 25 caught on undipped sheep, died in 24 hours. All the flies that died, including those from untreated sheep, showed symptoms of DDT poisoning within 15–30 minutes of capture. In a similar test five weeks after dipping, five of 16 flies from dipped sheep and one of 16 from undipped ones died. Even five weeks after dipping in DDT, contact with the fleece of a treated sheep for 30–60 seconds had a toxic effect on gravid females of *L. sericata*.

Experiments with artificial attractants on the sheep [*cf. R.A.E.*, B **26** 7] were carried out to show the action of the DDT dip in preventing oviposition. Tests were made every few days from 10th August to 21st September with five sheep that had been dipped in DDT on 8th August. They were compared with undipped sheep except on 21st September, when sheep that had been treated with a proprietary arsenical dip two days before were used as controls. On no occasion was a complete and compact batch of eggs laid on a sheep treated with DDT, whereas oviposition was invariably induced on the control group, even in the last test.

GILMOUR (D.), WATERHOUSE (D. F.) & MCINTYRE (G. A.). **An Account of Experiments undertaken to determine the natural Population Density of the Sheep Blowfly, *Lucilia cuprina* Wied.**—*Bull. Coun. sci. industr. Res. Aust.* no. 195, 39 pp., 3 pls., 1 fldg. map. 6 figs., 6 refs., multigraph. Melbourne, 1946.

The following is substantially the authors' summary. The natural population density of *Lucilia cuprina*, Wied., was estimated in 50 sq. miles of grazing country near Canberra by releasing known numbers of stained flies and recording the ratio of stained to unstained individuals in the catches of 102 traps placed within the area [*R.A.E.*, B **32** 81]. The results of four experiments carried out between November 1941 and March 1942 indicated that the natural population varied between 0·3 and 5·7 adult flies per acre. The distribution of stained flies was found to agree fairly well with a theoretical curve of distribution based on the assumption that the flies moved outwards at random. Their rate of dispersal varied from experiment to experiment, the differences showing some correlation with meteorological factors. The error involved in the method of estimating population density was found to be about 20 per cent. This does not include an error, which could not be measured, due to the possibility that the released flies did not constitute an accurate facsimile of the natural population. The population density was found to be relatively high in spring and autumn and low during summer, which agreed with previously recorded

observations on the seasonal variation in activity of *L. cuprina*. An analysis of the variation between individual trap catches showed that some of the variability was due to local differences in the natural population density. The mean catch per trap was found to vary directly as the population density, indicating that the effect of fly activity on the catch had been unimportant over the range of weather conditions encountered. The maximum distance from the point of release at which marked flies were taken was 4·7 miles. This distance was covered in less than 30 hours.

Nicol (G.). **Parasites of the Horse.**—*J. Dep. Agric. Vict.* **44** pt. 2 pp. 53–56, 5 figs. Melbourne, 1946.

The internal parasites of horses in Victoria include bot-flies and stomach worms and the external parasites comprise lice and mange mites. Very brief notes are given on the bionomics of *Gastrophilus intestinalis*, Deg. (*equi*, Clark), the commonest bot-fly [*cf. R.A.E.*, B **26** 151–152]. The eggs can be removed from the horse's hair by frequent grooming, preferably with a 0·5 per cent. solution of lysol, which aids hatching of the eggs not removed and destruction of the young larvae. Where infestation is heavy, the hair should be clipped and the clippings burnt. The larvae can be removed from the stomach by the administration of carbon bisulphide in capsules [**21** 49] or by the use of a solution of sodium bicarbonate followed by carbon bisulphide, both administered through a stomach tube. The small round stomach worms belong to the genera *Habronema* and *Draschia* and are transmitted by flies [*H. microstoma* by *Stomoxys calcitrans*, L., and *H. muscae* and *D.* (*H.*) *megastoma* by *Musca domestica*, L.]. The presence of the parasites may be associated with sores, splenic abscesses and eye tumours, and the large stomach tumours may break down with consequent rupture of the stomach. Treatment is the same as for *Gastrophilus*. The best treatment against the lice, *Haematopinus asini*, L., and *Werneckiella* (*Bovicola*) *equi*, L., is to clip the affected areas and apply a dressing of 1 per cent. carbolic acid or 0·06 per cent. nicotine sulphate. If these are not available, an emulsion made by dissolving 1 lb. soft soap in 1 gal. hot water and adding 1 pint kerosene as the solution cools is very effective. As the eggs are not destroyed by this treatment, it should be applied twice at an interval of 14 days in warm weather or three times at intervals of 20 days in cold weather. Mange is commonly caused by *Chorioptes equi*, Gerl., against which the recommended treatment is soaking the feet in a lime-sulphur wash four times at intervals of seven days [*cf.* **29** 105], but *Psoroptes hippotis*, Raill. & Henry, which is responsible for lesions about the ears of horses, has been found in Queensland.

Papers noticed by Title only.

[Pavlovskiĭ (E. N.).] **Павловский (Е. Н.). The Development of parasitological Investigations in Tadzhikistan** [including a review of 15 years' work on Arthropods parasitic on or otherwise injurious to man and domestic animals]. [*In Russian.*]—*Trud. tadzhik. Fil. Akad. Nauk SSSR* **21** pp. 101–127. Stalinabad, 1945.

Lane (J.). **Os Sabetíneos da América. (Addenda e Corrigenda).** [Additions, including two new species, and corrections to a revision of the American Sabethinae.]—*Rev. Ent.* **16** fasc. 1–2 pp. 132–157, 27 figs., 11 refs. Rio de Janeiro, 1945. [*Cf. R.A.E.*, B **31** 96.]

MANGABEIRA filho (O.). **2ª–13ª contribuição ao estudo dos** *Flebotomus*.—*Mem. Inst. Osw. Cruz* **36** fasc. 2 pp. 201–213, 2 pls., 14 refs., pp. 215–223, 2 pls., 10 refs., fasc. 3 pp. 237–250, 3 pls., 4 figs., pp. 251–262, 3 pls., 3 figs., 18 refs., pp. 369–377, 2 pls., 12 refs. Rio de Janeiro, 1941. *Op. cit.* **37** fasc. 2 pp. 111–218, 148 figs., 6 pp. refs., pp. 225–240, 11 pls., fasc. 3 pp. 241–250, 5 pls., 4 refs., pp. 251–257, 4 pls., 5 refs., pp. 287–295, 6 pls., 6 refs., pp. 327–331, 3 figs., pp. 375–381, 6 pls., 7 refs. 1942.

In the first six and the eleventh of these papers, the author describes 34 new species and five new subgenera of *Phlebotomus* (*Flebotomus*) from Brazil; in the eighth, ninth, tenth and twelfth, he describes the females and immature stages of four of these species and in the seventh he gives descriptions of both sexes and all stages of *P. avellari*, Costa Lima.

DE SOUZA-ARAUJO (H. C.). **Poderá o carrapato transmitir a lepra ?** [Can Ticks transmit Leprosy ?]—*Mem. Inst. Osw. Cruz* **36** fasc. 4 pp. 577–584, 2 pls. (1 col.), 10 refs. Rio de Janeiro, 1941.

DE SOUZA-ARAUJO (H. C.). **Poderá o carrapato transmitir a lepra ? Isolamento e cultura dum bacilo ácido-álcool resistente de sedimento de** *Amblyomma cajennense* **capturado em leproso. 2ª Nota.** [Can Ticks transmit Leprosy ? Isolation and Culture of an Acid- and Alcohol-fast Bacillus from Suspensions of *A. cayennense* taken on a Leper. Second Note.]—*Op. cit.* **37** fasc. 2 pp. 95–103, 3 pls. (2 col.), 10 refs. 1942. (With a Summary in English.)

DE SOUZA-ARAUJO (H. C.) & NORONHA MIRANDA (R.). **Poderá o carrapato transmitir a lepra ? Mais quatro amostras de culturas de bacilos ácido-álcool resistentes obtidas de carrapatos (2 de** *Amblyomma cajennense* **e 2 de** *Boophilus microplus*) **infectados em leprosos do Paraná. 3ª Nota.** [Can Ticks transmit Leprosy ? Four more Cultures of Acid- and Alcohol-fast Bacilli from Ticks (two of *A. cayennense* and two of *B. annulatus microplus*) infected by Lepers in Paraná. Third Note.]—*T.c.* fasc. 3 pp. 391–425, 23 figs., 19 refs. (With a Summary in English.)

DE SOUZA-ARAUJO (H. C.). **Infecção experimental de carrapatos** (*Amblyomma cajennense*) **em ratos com lepra Stefansky.** [Experimental Infection of Ticks (*A. cayennense*) from Rats with Stefansky Leprosy.]—*Op. cit.* **38** fasc. 2 pp. 183–186, 2 figs., 3 refs. 1943. (With a Summary in English.)

LINHARES (H.). **Possibilidades de transmissão e vias de inoculação da lepra murina em ratos e outros animais.** [The Possibilities of Transmission and Methods of Inoculation of Rat Leprosy in Rats and other Animals.]—*T.c.* fasc. 3 pp. 321–351, 101 refs. (With a Summary in English.)

DE SOUZA-ARAUJO (H. C.). **Infecção espontânea e experimental de hematófagos (Ixodídeos, Triatomídeos, Culicídeos, Hirudíneos, Pediculídeos e Cimicídeos) em leprosos. Possibilidade de serem eles vectores ou transmissores da lepra.** [Spontaneous and experimental Infection of Blood-sucking Organisms by Lepers. The Possibility of their carrying or transmitting Leprosy.]—*T.c.* pp. 447–484, 21 figs., 30 refs. (With a Summary in English.)

In the first of these papers, the author recapitulates Rudolph's finding, published in 1918, of the bacillus of human leprosy (Hansen's bacillus) in the intestine of nymphs of *Amblyomma cayennense*, F., that had fed up to 13 days previously on a subject suffering from tubercular leprosy during a febrile period, and states that he observed acid- and alcohol-fast bacilli resembling Hansen's bacillus in over 60 per cent. of smears prepared from suspensions of nymphs of this tick taken up to 48 hours previously from patients from a leper colony in

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Minas Gerais, Brazil. Smears from ticks taken from healthy persons, horses, dogs or plants were negative. In the course of the second paper, he records a similar finding for three adults of *Boophilus annulatus microplus*, Can., that were allowed to feed on lepers in Paraná. This tick frequently occurs on cattle in Brazil, but is not usually regarded as a common parasite of man. In further experiments, examples of it failed to attach themselves to lepers.

The third paper is divided into two parts. In the first, Noronha Miranda describes laboratory experiments from which he concludes that nymphs and females of *B. a. microplus* attack lepers almost as readily as does *A. cayennense*, that ticks of both these species sometimes engorge on them in 24 hours or less, after which they become detached, but may remain attached or re-attach themselves at other sites if engorgement takes longer, and that an interrupted meal can be completed by them on another individual. He also describes a severe dermatitis caused by the bites of ticks on lepers. In the second part, de Souza-Araujo records the finding of acid- and alcohol-fast bacilli in smears from ticks of both species supplied to him by the junior author after they had engorged on lepers. Cultures of the bacilli were established.

The fourth paper contains an account of experiments in which adults of *A. cayennense* taken from cattle sheds were induced to feed on rats infected with the bacillus of rat leprosy (Stefansky's bacillus). Smears prepared from a male and two females that fed close to a tumour showed the presence of typical bacilli. In the course of the fifth paper, in which the author discusses the ways in which rats acquire Stefansky's bacillus, he states that acid- and alcohol-fast bacilli similar to it were observed on several occasions in smears from lice (*Polyplax spinulosa*, Burm.) taken on infected rats.

In the sixth paper, records are given of the finding of acid- and alcohol-fast bacilli in ticks (*A. cayennense* and *B. a. microplus*) that had fed on lepers in various parts of Brazil, in some examples of *Triatoma infestans*, Klug, and *Panstrongylus megistus*, Burm., that were taken in the houses of lepers in Minas Gerais or allowed to feed on lepers in the laboratory, in adults of *Psorophora* spp. and *Aëdes crinifer*, Theo., and leeches taken feeding on afebrile lepers, and in one of several examples of *Phthirus* (*Phthirius*) *pubis*, L., from a leper. Tests with *Cimex lectularius*, L., from the houses of lepers all gave negative results.

DE ALMEIDA RODRIGUES (B.) & DE BRITO MELO (G.). **Contribuição ao estudo da tripanosomiase americana.** [A Contribution to the Study of American Trypanosomiasis.]—*Mem. Inst. Osw. Cruz* **37** fasc. 1 pp. 77–90, 2 pls., 1 map, 12 refs. Rio de Janeiro, 1942. (With a Summary in English.)

A survey was made from February to December 1940 for the presence of *Trypanosoma* (*Schizotrypanum*) *cruzi* and its Triatomine vectors in a forest settlement consisting of 42 dwellings in a marshy area in the delta of the Amazon. Previous records of Triatomines and of animal reservoirs of the trypanosome in the area are reviewed from the literature. No infection was found in any of the 117 inhabitants, either by examination of blood or by xenodiagnosis, for which the bugs selected were laboratory-bred examples of *Triatoma infestans*, Klug, *T. maculata*, Erichs., *Panstrongylus megistus*, Burm., and *Rhodnius prolixus*, Stål, and of five dogs and a cat examined by the same methods, infection was demonstrated in one dog, by means of xenodiagnosis. The strain isolated from it was atypical, but readily infected laboratory animals. Triatomines were taken in seven of the houses, mostly during the summer, and comprised 29 adults of *P. geniculatus*, Latr., nine of *R. pictipes*, Stål, and one of *Eratyrus mucronatus*, Stål; seven of the first and two of the second proved to be infected. Of these bugs, 22 (all *P. geniculatus*), of which six were infected, were taken in the dwelling in which the infected bug was found, but it is thought that the latter might have contracted the infection by feeding on the organs of infected wild animals. All the bugs taken in houses

were adults, but nymphs and adults of *P. geniculatus* (two of the adults of which were infected) were taken in the hole of an ant-eater (*T[amandua] tetradactylus*) near the house in which the 22 bugs were found, and an unidentified nymph and an adult of *P. rufotuberculatus*, Champ., which had not previously been recorded from this region, in holes of a monkey (*Aotus flavus*). Numerous wild animals were examined for infection, and some positive results were obtained in the case of *T. tetradactylus*, an opossum (*Didelphis* sp.), an armadillo (*D[asypus] novemcinctus*), a Mustelid (*T[ayra] barbara*) and unidentified bats. The strains isolated from them showed a weak virulence.

PONDÉ (R.), MANGABEIRA filho (O.) & JANSEN (G.). **Alguns dados sobre a leishmaniose visceral americana e doença de Chagas no Nordeste Brasileiro.** [Data on American Visceral Leishmaniasis and Chagas' Disease in north-eastern Brazil.]—*Mem. Inst. Osw. Cruz* **37** fasc. 3 pp. 333–352, 8 pls., 5 figs., 1 ref. Rio de Janeiro, 1942. (With a Summary in English.)

In view of the reports of cases of American visceral leishmaniasis [caused by *Leishmania chagasi* (*cf. R.A.E.*, B **34** 20)] in man in the States of Ceará, Pernambuco and Bahia, Brazil, and of one of Chagas' disease, caused by *Trypanosoma (S[chizotrypanum]) cruzi*, in Ceará, a rapid survey of the districts concerned was made in 1941–42. Further cases of visceral leishmaniasis were found in Ceará and Bahia, and the species of *Phlebotomus* (*Flebotomus*) taken in the affected localities were *P. longipalpis*, Lutz & Neiva, *P. villelai*, Mangabeira, *P. limai*, Fonseca, and *P. nordestinus*, Mangabeira, in Ceará, *P. evandroi*, Costa Lima & Antunes, *P. lenti*, Mangabeira, and *P. longipalpis* in Bahia, and the last-named in Pernambuco, where leishmaniae were observed in the liver and spleen of one out of three dogs. Cases of Chagas' disease were found by means of xenodiagnosis in Ceará and Bahia. *Panstrongylus megistus*, Burm., was taken in houses in both States, the percentages naturally infected being 13·5 and 65·5, respectively, and one example of *Triatoma* (*Eutriatoma*) *maculata*, Erichs. (uninfected) was taken in a house in Bahia. A dog in the latter State was found to be infected. *P. megistus* and *T. brasiliensis*, Neiva, were taken in houses in Pernambuco, but none was found to be infected. Clinical observations on the cases of visceral leishmaniasis are appended.

PINTO (C.). **Tripanosomiasis cruzi (doença de Carlos Chagas) no Rio Grande do Sul, Brasil.** [Chagas' Disease in Rio Grande do Sul, Brazil.]—*Mem. Inst. Osw. Cruz* **37** fasc. 4 pp. 443–537, 56 pls., 1 fldg. map, 21 pp. refs. Rio de Janeiro, 1942.

In this comprehensive survey, the author recapitulates the history of the discovery and the subsequent investigation of Chagas' disease, and discusses its pathology, diagnosis and treatment, and the recognition and classification of *Trypanosoma cruzi*, the causal organism, and its transmission through the excreta of Triatomine Reduviids. He gives lists of the wild and domestic mammals and of the Triatomines recorded in the literature as having been found naturally infected with *T. cruzi* in various countries and of the insects and ticks that have been infected experimentally. In collaboration with others, he has carried out investigations on the disease and its vectors in the State of Rio Grande do Sul, Brazil, since 1939, and he gives clinical details of the cases observed and lists, based on this work and the literature, of the Triatomines that have been found, in many cases in dwellings, naturally infected in various districts there. These comprise *Triatoma infestans*, Klug, *T.* (*Eutriatoma*) *oliveirai*, Neiva, Pinto & Lent, *T.* (*E.*) *rubrovaria*, Blanch., and *Panstrongylus megistus*, Burm.

The disease was transmitted experimentally to the coypu (*Myocastor coypus*) and a Mustelid (*Grison vittatus*) by intraperitoneal injection of excreta of infected examples of *T. infestans*, by this method and by contamination of the conjunctiva of the eye with excreta to young dogs and cats, and by the latter method to *Canis brasiliensis*. Natural infection was found in an armadillo (*Euphractus sexcinctus*) and also in a suckling pig that had been kept overnight in premises infested by *T. infestans*, of which 30 adults that were examined all proved to be infected.

The Scelionid, *Telenomus fariai*, Costa Lima, was found parasitising the eggs of *Triatoma infestans* in a dwelling in São Borja.

DE BEAUREPAIRE ARAGÃO (H.). **Uma estação biológica para o estudo dos mosquitos e dos outros animaes silvestres relacionados com a febre amarela.** [A biological Station for the Study of Mosquitos and other wild Animals connected with Yellow Fever.]—*Mem. Inst. Osw. Cruz* **38** fasc. 1 pp. 21–37, 7 figs., 4 refs. Rio de Janeiro, 1943. (With a Summary in English.)

BASSERES (M.). **Atividades da estação biológica de Perús.** [The Activities of the Perús Biological Station.]—*T.c.* pp. 39–52, 6 figs. (With a Summary in English.)

In order to facilitate observations on the mosquitos that transmit jungle yellow fever in Brazil [*cf. R.A.E.*, B **28** 169, 170] and the wild animals on which they feed, the first of a proposed series of field stations has recently been established in the forest near Perús, São Paulo. The station and its equipment are described in the first of these papers, and the daily routine observations carried out there in the second. Both contain accounts of preliminary work done and of the way in which jungle mosquitos were being reared in the open by collecting samples of water containing larvae in the forest and transferring them to special receptacles made from sections of bamboo stems, and also lists of the species of which larvae were observed. *Aëdes aegypti*, L., was not taken, and, in experiments recorded in the second paper, it could not be reared under natural conditions in the forest, even in summer, presumably because the temperature was too low. The second paper also contains information on the relative frequency of adult mosquitos in February–June 1938 and lists of those that attacked various animals and birds exposed in traps.

LENNETTE (E. H.) & FOX (J. P.). **Anticorpos neutralizantes para a amostra leste do virus de encefalomielite equina em equídeos no Brasil.** [Antibodies neutralising the Virus of Eastern Equine Encephalomyelitis in Equines in Brazil.]—*Mem. Inst. Osw. Cruz* **38** fasc. 1 pp. 85–92, 1 map, 22 refs. Rio de Janeiro, 1943. (With a Summary in English.)

An outbreak of equine encephalomyelitis occurred among horses in a county in the east of the State of Minas Gerais, Brazil, in 1940–41, causing considerable mortality. Serological tests showed that the virus responsible was identical with the eastern equine encephalomyelitis virus of the United States.

DIAS (E.) & TORRICO M. (R.A.). **Estudos preliminares sobre a doença de Chagas na Bolivia.** [Preliminary Studies on Chagas' Disease in Bolivia.] —*Mem. Inst. Osw. Cruz* **38** fasc. 2 pp. 165–172, 1 pl., 9 refs. Rio de Janeiro, 1943.

Chagas' disease, caused by *Trypanosoma* (*Schizotrypanum*) *cruzi*, has not been observed in man in Bolivia, though six species of Triatomine Reduviids occur

there. They comprise those recorded in a recent paper [*R.A.E.*, B **32** 13] with the exception of *Panstrongylus geniculatus*, Latr., and the addition of *Rhodnius pictipes*, Stål. Their distribution is reviewed from the literature. The authors have received specimens of *Triatoma infestans*, Klug, the commonest of them, from six of the nine Departments into which the country is divided, and of *T. sordida*, Stål, from one of these. Of 84 living nymphs and adults of *T. infestans* from the Department of Cochabamba, 44 voided infected excreta or were shown to contain the trypanosome in their stomach contents and the infection was transmitted to guineapigs and mice by injection of excreta. Examples of *T. infestans*, *R. prolixus*, Stål, and *P. megistus*, Burm., that fed on infected guineapigs acquired the trypanosome. Measurements of the forms observed in the blood of the laboratory animals are briefly discussed.

Dias (E.). **Presença de** *Panstrongylus megistus* **infectado por** *Schizotrypanum* **no Rio de Janeiro, D.F.** [The Presence of *P. megistus* infected by *Trypanosoma* (*Schizotrypanum*) in the Federal District of Rio de Janeiro.]—*Mem. Inst. Osw. Cruz* **38** fasc. 2 pp. 177–180, 2 figs., 1 ref. Rio de Janeiro, 1943.

The author records the capture of adults of *Panstrongylus megistus*, Burm., in houses in Rio de Janeiro in the summer of 1942–43. One male example was found to be infected with a trypanosome morphologically indistinguishable from *Trypanosoma* (*Schizotrypanum*) *cruzi*, and injection of its excreta into mice produced an inapparent infection. The other Triatomine Reduviids known from the Federal District of Rio de Janeiro are *P. geniculatus*, Latr., *Triatoma vitticeps*, Stål, *T. oswaldoi*, Neiva & Pinto, and *T. rubrofasciata*, Deg.

Hathaway (C. R.). **Associação entre Mallophaga e Hippoboscidae.** [Association between Mallophaga and Hippoboscids.]—*Mem. Inst. Osw. Cruz* **38** fasc. 3 pp. 413–417, 2 figs., 3 refs. Rio de Janeiro, 1943.

The author reviews the literature on the carriage of lice by Hippoboscids [*R.A.E.*, B **24** 23, 272, etc.] and states that during the examination of a pigeon in the laboratory, a Hippoboscid flew out from among its feathers. Seven Mallophaga were subsequently found attached to the abdomen of the fly. It would appear from the legends to the figures that the Hippoboscid was *Pseudolynchia canariensis*, Macq., and the Mallophaga, *Columbicola columbae*, L.

Lent (H.). **Triatomídeos da Guiana Holandesa. Redescrição de** *Panstrongylus lignarius* (Walker, 1873). [Triatomine Reduviids of Dutch Guiana. Redescription of *P. lignarius*.]—*Mem. Inst. Osw. Cruz* **38** fasc. 3 pp. 485–496, 9 figs., 20 refs. Rio de Janeiro, 1943.

The only Triatomine Reduviids hitherto definitely recorded from Dutch Guiana are *Triatoma rubrofasciata*, Deg., *T. maculata*, Erichs., and *Panstrongylus geniculatus*, Latr., but the author has recently received specimens of *P. lignarius*, Wlk., and *Rhodnius pictipes*, Stål, from that country, the latter represented by an adult male taken at light in Paramaribo in June 1941. He describes the adults of both sexes of *P. lignarius*, which has been recorded from British Guiana and northern Brazil (Pará), and gives characters distinguishing it from the closely related *P. humeralis*, Usinger, from the Panama Canal Zone.

LENT (H.). **Novo transmissor da doença de Chagas na cidade do Rio de Janeiro, D.F. Estudo dos gêneros *Belminus* Stål, 1859, *Bolbodera* Valdés, 1910 e descrição de *Parabelminus carioca* n.g., n.sp. (Hemiptera, Triatomidae).** [A new Vector of Chagas' Disease in the City of Rio de Janeiro. A Study of the Genera *Belminus* and *Bolbodera* and a Description of *Parabelminus carioca*, gen. et sp.n.]—*Mem. Inst. Osw. Cruz* **38** fasc. 3 pp. 497–516, 10 figs., 32 refs. Rio de Janeiro, 1943.

NERY GUIMARÃES (F.) & JANSEN (G.). **Novo transmissor silvestre do *Trypanosoma* (*Schizotrypanum*) *cruzi* (Chagas, 1909).** [A new wild Vector of *T. cruzi*.]—*T.c.* pp. 437–441, 1 pl., 3 figs. (With a Summary in English.)

In the first of these papers, the author reviews the status of the Triatomine genera *Belminus* and *Bolbodera*, redescribes the two species for which they were erected and gives a description of the adults of both sexes and the egg of *Parabelminus carioca*, gen. et sp.n., from material received from the authors of the second paper. The characters of the three genera are compared in a table.

All stages of *P. carioca* are stated in the second paper to have been found in nests of wild rats and the opossum, *Didelphis aurita*, in palms (*Attalea indaya*) at Santa Teresa, near Rio de Janeiro, in 1942. Nests of the opossum are fairly common in full grown palms in the district, and the bug was found in nine of 12 such palms investigated. One opossum in its nest proved to be infected with a trypanosome apparently identical with *Trypanosoma cruzi*. Of the 16 nymphs and adults of the bug that were examined, seven were infected with the trypanosome.

DE OLIVEIRA CASTRO (G. M.). **Ecologia do *Anopheles gambiae*. Pesquisas preliminares sôbre a viabilidade dos ovos que ficam fora da água.** [Ecology of *A. gambiae*. Preliminary Research on the Viability of Eggs kept out of Water.]—*Mem. Inst. Osw. Cruz* **38** fasc. 3 pp. 517–534, 2 refs. Rio de Janeiro, 1943. (With a Summary in English.)

Since it had been observed in the course of the work on the control of *Anopheles gambiae*, Giles, in Brazil [*cf. R.A.E.*, B **32** 159] that a certain valley rapidly became reinfested by the Anopheline after the first rains of the year, and that eggs that had been left in dishes in the laboratory, adhering to the sides above water level, hatched when the dishes were refilled, laboratory experiments were carried out in 1939 on the ability of the eggs to survive out of water [*cf.* **25** 254]. Eggs deposited on wet filter papers in the laboratory were exposed out of water for various periods to normal laboratory temperature and humidity or to a saturated atmosphere at laboratory temperature or at 14°C. [57·2°F.]. When the eggs were exposed on the same filter papers to normal temperature and humidity for seven days or for a month and then placed in water, none hatched. When they were kept on fresh filter papers in a saturated atmosphere in tubes and then transferred to a hollow in wet cotton wool, the percentages that hatched were 10, 12·4 and 0 after exposures of 8, 10 and 15 days, respectively, at laboratory temperature and 5, 0·1 and 0 after 15, 20 and 30 days at 14°C., excluding some eggs in each lot that hatched in the tubes owing to the high humidity. Only 54 per cent. of the control eggs that were kept in water under normal conditions hatched, and dissection showed that many of those that did not were sterile. The results of the tests were not affected by keeping the eggs on mud or waxed paper, or attaching them to the sides of the tubes. Eggs that were kept for 40 days in a refrigerator at approximately 0°C. [32°F.] in a normal or a saturated atmosphere all died.

In a subsidiary experiment, it was found that exposure to sunlight caused fourth-instar larvae to pupate within a few hours, whereas those kept in shade did not do so for a day or more, and that it increased the proportion of larvae

that moulted successfully and reduced the minimum duration of development from egg to adult from 8–9 days to 6–7 days. There was also some evidence that it stimulates hatching.

KNOWLES (F. L.) & FISK (F. W.). **DDT Water Emulsion in Rice Fields as a Method of controlling Larvae of *Anopheles quadrimaculatus* and other Mosquitoes.**—*Publ. Hlth Rep.* **60** no. 35 pp. 1005–1019, 1 pl., 9 figs., 3 refs. Washington, D.C., 1945.

An account is given of experiments made in Arkansas on the effectiveness of adding an emulsible DDT larvicide to the flooding waters at the pump for the control of mosquitos, principally *Anopheles quadrimaculatus*, Say, in rice-fields. The larvicide was composed of 20 per cent. DDT, 60 per cent. of one or a combination of various solvents and 20 per cent. Triton X-100 diluted with water to the desired concentration according to the rate of operation of the dispensing apparatus and the desired rate of application. In the method of dispensing adopted, water was pumped into an airtight bottle by a pump ordinarily used for chlorination and the displaced air was forced into another airtight bottle containing the larvicide, which was displaced through an outlet tube. The pump was adjusted to deliver a constant amount of water. It could not be used directly because of the effect of the solvents on it. Tests were made in a 100-acre field about a mile long and divided into six plots, and in 30 small plots each having an area of 0·05 acre. The sampling method is described, and the data obtained from 28,000 dipping records are given in some detail.

The following is taken from the authors' summary of the results. In the 100-acre field, the numbers of larvae increased with the distance from the pump, indicating a gradual loss in the toxicity of the treated water as it flowed through the canals and plots. Two plots of the treated field contained 50 per cent. fewer larvae of *A. quadrimaculatus* and 72 per cent. fewer larvae of *Psorophora* and *Culex* spp. than an untreated field. In the 0·05 acre plots where concentrations were compared and the factor of distance from the point of application was eliminated, complete control of larvae of the Anopheline and the other mosquitos was obtained at DDT concentrations of 1 and 0·2 parts per million, respectively. There was no lasting toxicity when only one application was made. Yields of harvested rice in the 100-acre field were higher than the average or highest yields for previous years from untreated fields. It is concluded that DDT did not injure the growing rice. The results indicate that the application of DDT to the flooding water as it enters the rice-fields reduces populations of mosquito larvae, but does not eliminate them.

LINDQUIST (A. W.) & DEONIER (C. C.). **Light-trap Studies of the Clear Lake Gnat.**—*J. econ. Ent.* **39** no. 1 pp. 11–14, 2 figs., 3 refs. Menasha, Wis., 1946.

The attraction of *Chaoborus astictopus*, Dyar & Shann., to lights [*R.A.E.*, B **31** 48] suggested that light-traps might be used to reduce its abundance near Clear Lake, California, and possibly also to reduce its breeding, and many types of light-traps incorporating suction produced by an electric fan were tested between 1938 and 1941, inclusive. In this paper, an account is given of experiments on the attractiveness of lights of various intensities and wave lengths. The following is substantially the authors' summary. With filament lamps the catch per unit of light decreased as the intensity of light increased. The catch with a 500-watt lamp was slightly more than 2·3 times that made by a 100-watt lamp. The catch in a double-action trap, with one 150-watt lamp above the motor and a second below, was nearly twice as great as in a single-action trap with a 300-watt lamp above the motor. A daylight fluorescent

lamp (15-watt) attracted 2·33 times as many of the insects as a filament lamp (60-watt) and took over six times as many per watt. Studies with larger fluorescent lamps and regular filament lamps showed that, on an equal lumen-rating basis, the fluorescent lamps were more attractive than the filament lamps and took up to 7·33 times as many of the insects per watt of electrical power. Daylight and blue fluorescent lamps were about equally attractive, but on the basis of catch per lumen, the blue lamp was considerably better. Daylight fluorescent lamps were more effective than white, pink, green or red fluorescent lamps.

ROARK (R. C.). **Feeding Chemicals to Plants and Animals for Pest Control.**—*J. econ. Ent.* **39** no. 1 pp. 35–38, 12 refs. Menasha, Wis., 1946.

The first part of this paper [*cf.* also *R.A.E.*, A **35** 175] consists of a review of the literature on the internal administration of chemicals to animals for the control of external parasites. The method did not appear promising when tested on fowls [B **16** 195], but it is pointed out that many of the substances that were used have no insecticidal value and others only a limited one. DDT administered orally to a rabbit was toxic to bed-bugs [*Cimex*] that subsequently fed on the animal [**32** 198], and pyrethrum extract [**32** 199] gave similar results not only with the bugs but also with stable flies [*Stomoxys calcitrans*, L.]. Phenothiazine fed to cattle prevented the development of larvae of the horn-fly [*Siphona irritans*, L.] in the droppings [**28** 133, etc.].

COTTAM (C.) & HIGGINS (E.). **DDT and its Effect on Fish and Wildlife.**—*J. econ. Ent.* **39** no. 1 pp. 44–52, refs. Menasha, Wis., 1946. **Correction.**—*T.c.* p. 295.

The results are given of observations made in various parts of the United States and in Ontario in 1945 on mortality of animals of various kinds caused by DDT applied from aircraft for the control of insects. The principal investigations were made where insects attacking forest trees were the object of control, but some were made on the effect of DDT applied to water against mosquito larvae and to cultivated land against insects attacking crops. The DDT was applied chiefly in oil solutions at concentrations that gave rates of 0·2–5 lb. per acre, but the amount that actually reached the vegetation showed considerable local variation from the specified rate of application, owing to bad weather, lack of landmarks, defective spray apparatus and different densities of vegetation. Most of the higher concentrations caused pronounced mortality of wild animals, whereas most of the lower ones had little or no effect ; but invertebrates and cold-blooded vertebrates were more readily affected than birds and mammals and all concentrations caused mortality of fish. In two cases, DDT was applied as a dust, at rates of 25 and 1·5 lb. per acre, respectively. The higher rate caused noticeable mortality of birds, but the lower one did not.

In experiments, DDT was much more toxic to birds in vegetable-oil solution than in the crystalline form and to fish in emulsions than in oil solutions ; very few fish were killed by a suspension of DDT and none by feeding on insects killed by DDT.

On the basis of these results, the authors recommend that DDT should not be used without due consideration. It should be applied at the minimum effective dosage, not in emulsions, and at less than 0·2 lb. per acre in oil solution to avoid damage to fish, crabs or crayfish and at less than 2 lb. per acre to avoid damage to birds, amphibia and mammals in forest areas. It should be applied evenly, only in calm dry weather and only where it is needed. In forests, treated and untreated strips should be alternated in order to disturb animals as little as possible, and the DDT should be applied just before the appearance of

leaves and the main spring migration of birds to control insects that appear early in the season, and after the nesting season, which lasts to the middle of August, against late insects. DDT should not be applied directly to streams, lakes and coastal bays, because of the susceptibility of fish and crabs.

WISECUP (C. B.), BROTHERS (W. C.), EIDE (P. M.) & DEONIER (C. C.). **DDT Emulsion applied to Rice-field Water to control Mosquitoes.**—*J. econ. Ent.* **39** no. 1 pp. 52–55, 2 refs. Menasha, Wis., 1946.

Work in Florida in 1943 and the early spring of 1944 had shown that DDT was promising for the control of larvae of species of *Anopheles* and *Psorophora* [*R.A.E.*, B **34** 130, 131]. Large-scale tests on its use for controlling these mosquitos in irrigated areas were made in the rice-growing area of east-central Arkansas from May to September 1944 [*cf.* **35** 52, 87]. The local irrigation practice is described [**35** 52]. In the experiments dealt with in this paper, emulsions made from a concentrate of 20 per cent. DDT, 60 per cent. xylene and 20 per cent. Triton X-100 diluted with water to contain 1–10 per cent. DDT were applied to flowing irrigation waters in 16 tests involving over 730 acres of rice in ten fields. Various methods of application were tested, and primary dependence was finally placed on drip cans equipped with a metering valve (a fuel valve from an oil heating stove), but these were not entirely satisfactory and improvements must be sought. The emulsion was applied at the wells, from which the water had sometimes to be conveyed nearly a mile in open ditches.

The area over which control was obtained and the period for which it persisted with concentrations of DDT varying from 0·035 to 1·19 part per million and anticipated dosages per acre varying from 0·04 to 1·9 lb. are shown in a table, in which the distance from the point of application to the point where the water entered the field is also indicated. These results are also discussed. No reduction in population of larvae was noted beyond the first few contours when the concentration of DDT was less than 0·1 p.p.m. In three tests with a concentration close to 0·2 p.p.m., initial breeding was entirely prevented only in the smallest field (11 acres), which received water straight from the well. Since the field was subjected to a long period of irrigation, a dosage equal to 1·16 lb. DDT per acre was applied. There was no breeding in this field for six weeks, despite two re-floodings with untreated water. In tests with concentrations near 0·4 p.p.m., the only field in which control was complete was again the smallest (30 acres), which also received water direct from the well. At 0·6 p.p.m., all fields received an average dosage of about 1 lb. DDT per acre, and this gave complete initial control. In a 40-acre field that received its water from a 1,500-ft. canal, breeding was resumed almost immediately. Toxicity persisted for two weeks in a 20-acre field to which the water came through a 2,500-ft. canal, and control was complete for five weeks in a 30-acre field that received its water direct from the well. Of the fields treated at about 1 p.p.m., a 70-acre field that received about 1·5 lb. DDT per acre retained its toxicity for only three weeks, whereas 40- and 35-acre fields receiving rather more DDT per acre were free of larvae for six and seven weeks, respectively. All the water had come through canals. The basic concentrate tended to break and become dissipated when diluted in the deep-well irrigation waters. Subsequent laboratory tests showed that intense aeration of water containing DDT emulsions and suspensions caused a decided loss of toxicity to mosquito larvae.

It is concluded that the treatment is practicable for fields up to 70 acres in extent when the irrigation flow is about 1,000 U.S. gals. per minute. The DDT should be applied at about 1 p.p.m. close to the point where the water enters the

field. The emulsions did not damage the current crop of rice, but repeated applications might in time leave residues in the soil deleterious to certain plants.

LINDQUIST (A. W.), JONES (H. A.) & MADDEN (A. H.). **DDT residual-type Sprays as affected by Light.**—*J. econ. Ent.* **39** no. 1 pp. 55–59. Menasha, Wis., 1946.

Tests were carried out in Florida and Texas to determine the effect of exposure to ultra-violet light and sunlight on the toxicity of deposits of DDT, particular attention being given to those obtained from solutions of 5 per cent. DDT in kerosene with the addition of 15 per cent. of various auxiliary solvents, since it has sometimes been necessary to use such solvents to prevent crystallisation of DDT from kerosene at low temperatures. Solutions, emulsions and suspensions were applied to unpainted plywood boards and glass petri dishes to give a deposit of 200 mg. DDT per sq. ft.; and exposed and unexposed deposits were tested against adults of *Musca domestica*, L., by determining the time required for knock-down. Several series of tests were made with various periods of exposure to the light from an ultra-violet lamp. In one series, the surfaces were sprayed with solutions of DDT in kerosene, with and without auxiliary solvents, a solution in No. 2 fuel oil and an aqueous suspension made with a wetting agent mechanically dispersed in water, and were exposed for 132 hours six days later and tested for knock-down immediately or 72 days after exposure. In another series, kerosene solutions alone or with auxiliary solvents were applied, and the residues were exposed for 88 hours and tested 46 days later. Exposure to ultra-violet light reduced the effectiveness of all treatments except the aqueous suspension applied to glass, as shown by the longer time required for complete knock-down, both for tests immediately after exposure and those made after an interval. The loss of effectiveness was greater, particularly on the impervious surface, after the use of auxiliary solvents with high boiling points or ranges, which were generally found to decrease the knock-down time for several days after treatment if the surface remained unexposed to light. Such deposits were still liquid at the time of testing; the toxic action of DDT is more rapid under these conditions. When the residues from a solution of DDT in kerosene on glass plates, which had been rendered comparatively ineffective by exposure to the lamp for several days, were treated with acetone, flies exposed to them were knocked down almost as soon as before ultra-violet treatment, because the acetone dissolved and distributed the whole deposit, bringing some of the undecomposed DDT to the surface.

In tests on the effect of sunlight, treated plywood boards and glass plates were exposed to sunlight for nine hours a day until the desired number of hours was reached; they were put under cover at night, and additional exposure was made to compensate for periods of cloudiness. Some samples were protected from rainfall, and others received one inch of rain. Exposure for 90 hours reduced the effectiveness of deposits from solutions of DDT in kerosene, with or without auxiliary solvents, and from solutions in fuel oil. The loss was greatest when a high-boiling auxiliary solvent was used. The residues from an emulsion made from a concentrate of DDT, Triton X-100 and xylene (25 : 10 : 65) diluted with water (1 : 4) and an aqueous suspension were not seriously affected, especially on glass.

As these results indicated a possible relation between the volatility of the auxiliary solvent and the effect of exposure to sunlight, another test was carried out with solvents chosen to give further indications on this point. The deposits were exposed for 135 hours over a period of 18 days and it was found that the degree of decomposition by light was somewhat in the order of the boiling range of the auxiliary solvent. Deposits from those with boiling ranges near or below that of kerosene all showed practically no loss in effectiveness on wood and much less reduction on glass than those containing the high-boiling

solvents, which showed marked reductions on both surfaces. Deposits from the aqueous emulsion and suspension again showed little or no loss in effectiveness, and a solution in fuel oil showed some reduction on wood and a heavy reduction on glass.

The results indicate that DDT is more rapidly and completely decomposed in solution than as a solid deposit. Comparatively dry deposits, such as those from the suspension and emulsion, show least decomposition. Kerosene solutions made with non-volatile solvents remain liquid for long periods and thus permit penetration of the light rays and resulting decomposition.

DAVIS (J. J.). **DDT to control Household and Stored Grain Insects.**—*J. econ. Ent.* **39** no. 1 pp. 59–61. Menasha, Wis., 1946.

It is stated in the course of this paper [*cf.* also *R.A.E.*, A **35** 178] that infestations of the brown dog tick [*Rhipicephalus sanguineus*, Latr.] in buildings can be eradicated in a fortnight by a single properly made application of a 10 per cent. DDT dust or a 5 per cent. spray. Dogs should be treated with the powder at the same time. A 5 per cent. dust applied under and immediately round an open porch in Indiana where a dog slept eliminated fleas, which had been troublesome on a neighbouring lawn. Commercial experience in the United States has indicated that a 10 per cent. DDT powder gives excellent control of the American and the Oriental cockroaches [*Periplaneta americana*, L. and *Blatta orientalis*, L.] in houses but gives inconsistent results against the German and the brown-banded cockroaches [*Blattella germanica*, L., and *Supella supellectilium*, Serv.]. An Army entomologist has reported satisfactory control of *B. germanica* throughout his command [*cf.* B **34** 84], and this may have been due to more frequent treatments than are made in commercial practice. A 25 per cent. DDT concentrate has been reported effective in dog food against *B. germanica* and *P. americana* [*cf.* **32** 205] and as effective against *S. supellectilium* when applied as a spray to leave a toxic residue in places where this species hides, such as behind pictures and in drawers, piano cases, etc. It is concluded that sodium fluoride, with or without pyrethrum, is still preferable to DDT for commercial use against cockroaches, especially as a single application of DDT tends to scatter an infestation over the house before control is achieved.

MATTHYSSE (J. G.). **DDT to control Hornflies and Gulf Coast Ticks on Range Cattle in Florida.**—*J. econ. Ent.* **39** no. 1 pp. 62–65. Menasha, Wis., 1946.

An account is given of experiments carried out in southern Florida from the middle of July to the middle of September 1945 on the use of DDT for the control of the horn-fly, *Siphona irritans*, L., on range cattle. The tests involved 8,402 cattle in 36 herds. No horn-flies were seen for the first three days after spraying, but the severe weather conditions with intense heat, high humidity and particularly the almost daily tropical downpours quickly rendered low concentrations of spray ineffective. The deposits from sprays containing 0·1–0·2 per cent. DDT gave effective control for less than a week. It was necessary to raise the concentration of emulsions to 2·5 per cent. DDT to get a deposit effective for ten days and that of suspensions to 1 per cent. to get deposits effective for two weeks. Suspensions left more lasting deposits than emulsions at all concentrations, probably on account of masking against sunlight by the suspension carrier and washing off of the emulsions through their high content of wetting agent. Dips containing 0·1–0·25 per cent. DDT as a wettable powder were more effective than spray suspensions at the same concentrations, probably because of the larger amount of DDT on the animal and complete coverage, but no dip approached the higher concentrations of suspension sprays in effectiveness, and dipping is a very wasteful method. Spray suspensions containing

1 per cent. DDT gave a deposit that was lethal for almost two weeks and left populations at an insignificant level for more than a month after spraying. The increased effect of higher concentrations was not considered to justify the extra cost. The results obtained with the six different spraying procedures used, in some of which only the heads, shoulders and backs of the cattle were sprayed, were not found to differ significantly from one another. A very rapid and effective method was to arrange many nozzles inside a chute so as to cover the whole bodies of the cattle as they ran through. The treatment apparently reduced populations of mosquitos (mostly *Aëdes* and *Psorophora* spp.) in some instances, but had little effect on Tabanids.

Inclusion of 8 per cent. DDT in greases containing 26 per cent. sulphur or use of a spray emulsion containing 4 or 5 per cent. DDT and an adhesive for application to the ears of cattle against *Amblyomma maculatum*, Koch, gave complete and almost complete protection for 4 and 6 weeks, respectively, from the infestations of screw-worms [*Cochliomyia hominivorax*, Coq.] that develop in wounds made by this tick, whereas 5–10 per cent. of untreated cattle were infested.

LAAKE (E. W.). **DDT for the Control of the Horn Fly in Kansas.**—*J. econ. Ent.* **39** no. 1 pp. 65–68, 1 fig. Menasha, Wis., 1946.

The horn-fly [*Siphona irritans*, L.] is a serious pest of cattle throughout Kansas from June to September. During the summer of 1945, tests were carried out in 16 counties to determine the value of DDT sprays and dips for its control and the duration of their effectiveness under field conditions, and also to familiarise stock owners with the use of DDT for controlling flies and other external parasites. When the tests were begun, beef cattle carried 500–1,500 horn-flies each and bulls as many as 10,000, and by August, untreated cattle and bulls carried as many as 3,000 and 20,000. The DDT, in the form of a water-dispersible powder, was diluted with water to give a suspension containing 0·2 per cent. DDT for the sprays and 0·1 per cent. for the dips. The sprays were applied with power apparatus to the upper half of the body and to the neck and head of the cattle at about 2 U.S. quarts per adult animal and 1 U.S. quart per calf. Results were best when the nozzles were held close to the animal. The first and second applications of spray gave protection for about 14 and 21 days, respectively, whether the whole or half of the herd was treated, but the third application protected for 21 days if half the herd was treated or about 30 if the whole was sprayed. The longer protection is considered to justify treatment of the whole herd. The fourth application, which was made to the whole herd, gave protection for 32 days. Four dippings were effective for as long as four sprayings, but required about three times as much DDT, owing to the greater amount of liquid needed to charge the vat.

The treated cows and calves on three ranches gained 42·2–51 and 46·9—70 lb. more, respectively, than the untreated ones. On a fourth ranch on which the test lasted only 60 days, there was an increased gain in weight of 30 lb. per animal. The increased gain varied from 430 lb. per lb. DDT used where treatment was by dipping to 2,306 lb. per lb. DDT on one of the sprayed ranches. It is estimated that the loss of beef in Kansas in 1945 due to the horn-fly would be 85,980,000 lb.

Sprays of 5 per cent. DDT emulsion applied to nine barns to leave a toxic residue for the control of *Musca domestica*, L., and *Stomoxys calcitrans*, L., kept the buildings practically free of these flies for 73–98 days. One barn sprayed with 2·5 per cent. DDT in suspension was practically free for 90 days, whereas a long shed sprayed very heavily with a 0·2 per cent. emulsion remained free for only two weeks. Other barns heavily sprayed with 0·2 per cent. in suspension or emulsion remained free for at least three weeks. Therefore, if the interiors of

barns are thoroughly sprayed with 0·2 per cent. DDT when the cattle are sprayed against horn-flies, excellent control of *S. calcitrans* and *M. domestica* should be obtained as well.

CARPENTER (S. J.) & CHAMBERLAIN (R. W.). **Mosquito Collections at Army Installations in the Fourth Service Command, 1943.**—*J. econ. Ent.* **39** no. 1 pp. 82–88. Menasha, Wis., 1946.

The mosquito collections made in 1943 at army installations in Tennessee, North and South Carolina, Mississippi, Alabama, Georgia and Florida are summarised [*cf. R.A.E.*, B **32** 194]. For each State, a list is given of the species found, showing the numbers of adults and of larvae taken, and the months and localities of collection.

BICK (G. H.). **Collections of Mosquitoes on Parris Island during 1945.**—*J. econ. Ent.* **39** no. 1 pp. 89–91, 2 refs. Menasha, Wis., 1946.

About 40 per cent. of the area of Parris Island, which lies in the coastal plain of South Carolina and is six miles long by three miles wide, is tidal marsh subjected to a 10-ft. tide twice daily. The highest point is about 10 ft. above mean high-tide level. Rainfall is highest from June to September. Details are given of collections of adult mosquitos made at ten diurnal resting stations on the island from June to the end of September, of biting records at the same stations in August and September and of collections of larvae made from June to the end of September in surface water, pot holes, ditches, marshes, artificial containers and tree holes. The adult resting stations were established in situations considered favourable to *Anopheles quadrimaculatus*, Say. A few records for other months of the year are included. Intensive mosquito control operations were in progress during the collecting period and had been going on for more than a year. Nearly 30 species belonging to seven genera were recorded. *Aëdes taeniorhynchus*, Wied., *Culex fatigans*, Wied. (*quinquefasciatus*, auct.), *A. sollicitans*, Wlk., and *Psorophora ciliata*, F., were the most common adults. The density of *Anopheles quadrimaculatus* was significantly below the general level for the south-eastern United States and decreased as summer progressed. Temporary surface water was the most productive larval habitat, but only insignificant numbers of larvae of *Anopheles* spp. were taken.

PEAIRS (L. M.). **DDT and Hornfly Populations.**—*J. econ. Ent.* **39** no. 1 pp. 91–92. Menasha, Wis., 1946.

Tests of DDT for the control of horn-flies [*Siphona irritans*, L.] in pastures were made in West Virginia in 1945 on a herd of 65 heifers that were kept on pasture throughout the summer but were fed daily in a barn. The animals were sprayed on 11th July after a considerable population of flies (at least 500 per animal in the afternoon) had developed. A water-miscible preparation containing 40 per cent. DDT diluted to 2 lb. DDT to 100 U.S. gals. water, was applied to them in the feeding stalls with a sprayer that delivered at a pressure of 250 lb. or more. The nozzle was run along one side of the back, over the neck and along the opposite side. The bases of the ears and tops of the heads received some spray, but the faces and undersides were not treated. It is estimated that more than 2 U.S. quarts spray were used per animal. The absence of flies from the cattle was noticeable from the afternoon of the day of treatment, and the horn-fly population did not re-establish itself during the season. In late September and early October, the average number of horn-flies per animal was not greater than 20. Other flies were present but only in small numbers. It is thought that the greater persistence of effectiveness here than in other parts of the United States [*cf. R.A.E.*, B **35** 91, 92] may be attributed

to more thorough treatment, the high pressure at which the spray was applied, favourable weather with no heavy storms and access to shelter for the cattle during rain, and above all to the fact that the area is hilly and partly wooded with a low population of farm animals and natural barriers to fly migration between pastures.

PARISH (H. E.) & RUDE (C. S.). **DDT to Control the Winter Horse Tick.**—*J. econ. Ent.* **39** no. 1 pp. 92-93. Menasha, Wis., 1946.

Dermacentor nigrolineatus, Pack., one of the major external parasites of horses over a large area of the United States, is most active in the cold weather. On the Edwards Plateau of Texas, it is found on animals from November to the middle of March and is most abundant in December or January. The effects of infestation on horses are described. Cattle are also attacked, injury being considerable in young calves. Heavy infestation may prove fatal to both horses and cattle. Preliminary tests with DDT carried out in 1943–44 showed that a wash containing 0·4 per cent. would give complete kill of ticks but only limited protection from reinfestation, whereas one containing 0·8 per cent. gave protection for much longer. Eleven experiments involving 175 horses were made in 1944–45. The animals were sponged with a wash containing 0·8 per cent. DDT prepared by adding 6 fl. oz. of a stock concentrate to 1 U.S. gal. water and stirring gently until a uniform mixture was obtained. The concentrate was made by placing one part by weight of DDT and five parts of a soluble pine oil in a tight container and shaking vigorously until the DDT was dissolved. In applying the wash, the sponge should be rubbed against the lie of the hair and the whole body of the animal must be thoroughly treated. This requires quantities of wash varying from 2 U.S. quarts to 2 U.S. gals. per horse. Large numbers of animals may be treated with a power sprayer, while passing through a chute.

The heads of all the experimental horses were left untreated as controls. In all cases, ticks continued to attach and feed on the heads. One week after treatment, 83·5 per cent. of the horses were free of ticks, 16 per cent. had a few ticks, and 0·5 per cent. were still heavily infested. These results clearly showed that thorough application is essential and that the wash can give complete control if care is taken to wet the whole animal. Some horses that had a few ticks on them when first examined were entirely free at the second examination and remained free for a considerable time. Of the horses treated, 26 per cent. remained free of infestation throughout the season, 36 per cent. became lightly reinfested but required no further application of the wash and 38 per cent. required a second treatment. Only three needed a third treatment to keep them relatively free of ticks through the season. The average period of protection was 45 days. Horses on which nymphs were present at one examination were often free of ticks at the next. No harmful effects to the hair or skin of any of the animals were noted.

MACKERRAS (I. M.) & WEST (R. F. K.). **"DDT" Poisoning in Man.**—*Med. J. Aust.* March 23rd 1946 p. 400 repr. 4 pp., 1 ref. Sydney, 1946.

Accounts are given of four cases of DDT poisoning observed in New Guinea. The first two were the most severely affected of some 25 men who ate a tart in which DDT had been used in mistake for baking powder. All the men were affected to some extent and all recovered within 48 hours. The third case was a man who had been applying a solution of DDT in oil from a dropper bottle against mosquito larvae and who had been using a bottle that lacked a protective collar round the neck, probably for several weeks, so that his right hand had become covered with DDT solution on six days of the week. He developed swelling, numbness and weakness of the right hand and arm and suffered from

headaches and vomiting, and his temperature rose to 101°F. Most symptoms disappeared four days after he stopped duty and muscular power became normal in a fortnight. The fourth man got DDT powder in his eyes and became blind for a fortnight. Recovery was complete. The early signs of DDT poisoning are summarised; any men who show numbness, weakness and headache should be immediately relieved of any duties that involve the handling of DDT until they have completely recovered.

CAMERON (A. E.). **Insect Pests of 1944.**—*Trans. Highl. agric. Soc. Scot.* (5) **57** pp. 54-72 6 figs., 5 refs. Edinburgh, 1945. **Insect and other Pests of 1945.**—*Op. cit.* (5) **58** pp. 100–120, 10 figs., 6 refs. 1946.

The first report includes notes on the bionomics of *Simulium ornatum*, Mg. [*R.A.E.*, B **23** 131], which is not known to have been previously recorded as a pest in Scotland, but was very troublesome to horses and cattle in pasture-land to the west of Edinburgh in June 1944. It had also been reported to be molesting man near Edinburgh in April when its presence on the farm animals was first noticed.

As publicity has recently been given to the problem of biting midges (*Culicoides*) in Scotland, the subject is briefly dealt with in the second report, although they were no more abundant than usual in 1945. Much of their bionomics is not well known. The species identified from catches made from July to October in trap-boxes set out on the surface of the ground in a boggy moorland locality in Peebles were *C. pallidicornis*, Kieff., *C. pulicaris*, L., *C. delta*, Edw., *C. impunctatus*, Goetgh., *C. obsoletus*, Mg., and *C. cunctans*, Winn., which are given in order of abundance, the first far outnumbering the others. Although about a dozen Scottish species are known to attack man, only *C. impunctatus*, *C. obsoletus*, *C. heliophilus*, Edw., *C. pulicaris* and possibly *C. pallidicornis* are troublesome, the first far the most so. The problem of midges is less important in the lowland districts than in the Highlands, but *C. obsoletus* and *C. heliophilus* are often plentiful locally in rural and suburban areas. Unlike most species, *C. heliophilus* is most active during the middle of the day and disappears before evening when others are most in evidence. Under dull, sultry conditions, both *C. impunctatus* and *C. obsoletus* may appear early in the afternoon. A generalised life history is given. Control of the larvae is impracticable as the breeding places are too varied and little known. The larvae of some species, probably the majority, occur in damp soil or decaying vegetation, and even those that occur in water would not be affected by the surface treatments used against mosquito larvae, as they do not come to the surface to breathe, but obtain oxygen from that dissolved in the water by diffusion through the cuticle. Tests of various pastes, lotions and emulsions incorporating dimethyl phthalate as a repellent made on volunteers in infested districts of Scotland in 1945 showed an emulsion comprising 5 gm. Lanette Wax S. X., 9 cc. triethanolamine, 27 cc. oleic acid, 100 cc. dimethyl phthalate and 100 cc. water to be satisfactory. It should be applied to exposed surfaces of the body but should not be allowed to get into the eyes. Such treatment gives relief from attack for 2–3 hours.

VAN SOMEREN (E. C. C.). **Ethiopian Culicidae—Descriptions of the Adults and Pupae of two new Species and two Subspecies of the Genus *Aëdes* from East Africa (Diptera).**—*Proc. R. ent. Soc. Lond.* (B) **15** pt. 1–2 pp. 1–6, 2 figs., 1 ref. London, 1946.

Descriptions are given of the adults and terminalia of *Aëdes* (*Stegomyia*) *bambusae kenyae*, subsp.n., *A.* (*S.*) *langata*, sp.n., *A.* (*Dunnius*) *michaelikati*, sp.n., and *A.* (*D.*) *m. gurneri*, subsp.n., and of the pupae of the last three. All are from Kenya; *A. michaelikati* was found in Gede, *A. m. gurneri* in the Langata Forest and Nairobi, *A. langata* in the Langata Forest, and *A. b. kenyae* in Kaimosi, Kitale and Kisii [*cf. R.A.E.*, B **34** 93].

Smart (J.). **The Classification of the Simuliidae (Diptera).**—*Trans. R. ent. Soc. Lond.* **95** pt. 8 pp. 463–528, 6 pp. refs. London, 1945.

The earlier classifications proposed for Simuliidae are outlined, and the work of Enderlein and Edwards is examined in some detail. The author follows Edwards [*R.A.E.*, B **20** 14] in the delimitation of segregates within the family but differs from him in the taxonomic status accorded to them. Two subfamilies are recognised, Parasimuliinae and Simuliinae. The former contains the genus *Parasimulium* and the latter contains the genera *Prosimulium*, *Cnephia*, *Austrosimulium*, *Gigantodax* and *Simulium*, which comprises the subgenera *Simulium*, *Eusimulium* and *Morops*. A key to the genera and a catalogue of the species are given.

Grass Itch Mites (*Acomatacarus australiense*).—*Agric. Gaz. N.S.W.* **57** pt. 2 pp. 87–88, 1 fig. Sydney, 1946.

Acomatacarus (*Leeuwenhoekia*) *australiensis*, Hirst, has been known for many years in the Sydney district [*R.A.E.*, B **13** 190], where it is distributed sporadically, chiefly on clay soils in the western suburbs. Every year from September to April, large numbers of people working in their gardens or in grassy areas are attacked by the larvae and develop irritating swellings that remain inflamed for several days. The larvae may be found clustered in the ears of domestic cats, and also occur on wild birds and animals, but have not been recorded on poultry. The adults lay their eggs in batches in the soil. Suggested control measures are dusting the ground with 1 lb. sulphur per 200 sq. ft. [*cf.* **32** 200] and treating the clothing with dibutyl phthalate [*cf.* **34** 143]. As *A. australiensis* is known to be a comparatively resistant species, it is assumed that clothes treated at the rate of 1 fl. oz. for shirt, trousers and socks would give protection until after three washes with warm water or one boiling. Ironing does not affect the treatment. A description is given of the simplest method of application by dipping the finger tips into the fluid, rubbing the hands together and wiping them on the article. Application from a narrow screw-top bottle, filled with a leather washer and having very small holes punched in the metal cap, has some advantages. The dibutyl phthalate is poured in with four times its bulk of water, and the two are kept in temporary emulsion by the shaking required to expel the liquid through the small holes. For gardening, treatment of socks only would be sufficient. Dibutyl phthalate used as described is harmless to the skin of adults, but as its effect on children is not yet known, it is suggested that whereas the clothing of adults and children's socks may be worn when freshly treated, children's underclothes should be washed after treatment. Dibutyl phthalate does not affect wool or cotton, but may damage some artificial fibres, as it is a powerful solvent of plastics.

Papers noticed by Title only.

Common Names of British Insect and other Pests. Part I. Slugs and Snails : Eelworms : Beetles : Flies : Sawflies, Wasps and related Insects.—30 pp., Association of Applied Biologists, 1947. Price 2*s*. (Copies obtainable from Dr. I. Thomas, 47, Tennyson Road, Harpenden, Herts.) [See *R.A.E.*, A **35** 194.]

Bequaert (J.). **Dr. Luis Vargas on American Black-flies—a Review, with critical Notes (Diptera).**—*Bull. Brooklyn ent. Soc.* **40** (1945) no. 4 pp. 111–115. Lancaster, Pa., 1946. [*Cf. R.A.E.*, B **33** 125.]

GJULLIN (C. M.) & MOTE (D. C.). **Notes on the Biology and Control of** *Chrysops discalis* **Williston (Diptera, Tabanidae).**—*Proc. ent. Soc. Wash.* **47** no. 8 pp. 236–244, 1 pl., 5 refs. Washington, D.C., 1945.

Chrysops discalis, Will., which is widespread in the north-western United States, is a severe pest of cattle, horses and man on ranches in the Summer Lake Valley of Oregon, where the adults are present from mid-June to the beginning of September. They have been found to be fairly numerous 4–5 miles from their breeding places. Livestock in the area is also attacked by *Tabanus productus*, Hine, *T. sonomensis phaenops*, O.-S., and *T. punctifer*, O.-S., but these species are less numerous. *C. discalis* is known to transmit tularaemia [*R.A.E.*, B **9** 188; **25** 133], and cases in man occur in the Valley almost every year. There were six in 1943, when nearly all the rabbits in the valley were destroyed by the disease, and none in 1944, presumably because of the reduction in the rabbit reservoir.

The waters of Summer Lake and Rest Lake, in which the fly breeds, are shallow and highly alkaline; the mud was found to have a pH of 8·8–9·6, and is saturated with hydrogen sulphide. In July 1944, larvae of *C. discalis* were found buried to a depth of 2–4 ins. in mud samples taken as far as 100 ft. from shore under water as much as 2 ft. deep. Many larvae, pupae and pupal cases were present in the soil near the edge of the lakes. It was estimated that 90 per cent. of the flies from one area had emerged by 22nd July. There were large numbers of egg-masses on the stems of *Scirpus americanus* on 25th August, but none on other plants. All these eggs had hatched by 18th October, and the young larvae were found in the mud from near the shore to 30 ft. out in the lake. Some large larvae obtained in July, as well as small larvae obtained in October, occurred half a mile from vegetation of any kind, and as larvae have been observed to float on the surface of the water at times, they may have been carried to these places by water currents or wave action. The egg stage lasted 5–6 days, and the first moult occurred about an hour after hatching. The pupal stage lasted 5–9 days.

Sprays containing 2 or 4 per cent. DDT made from a concentrate consisting of 25 per cent. DDT, 68 per cent. xylene and 7 per cent. Triton X-100 and applied to cattle at the rate of ½ U.S. gal. per animal did not noticeably reduce the numbers of *Chrysops* alighting and feeding on them. Flies exposed for 2–15 minutes to a dry DDT deposit by confining them in glass jars that had contained the 2 per cent. DDT emulsion were unable to fly 30 minutes later. Those exposed for 2 minutes were dead in eight hours, and 90 per cent. of those exposed for 10 or 15 minutes were dead in four hours. This indicates that all flies that feed on treated animals would eventually be killed, as several minutes are necessary for a blood-meal, but it is doubtful whether this would give much relief in the Summer Lake Valley, even if all the cattle in it were sprayed. The same type of emulsion was tested against first- and second-instar larvae of *C. discalis* in tap water. One part DDT in 1,000,000, 5,000,000 and 10,000,000 parts water gave 100, 98 and 72 per cent. mortality in 48 hours.

DAVIS (D. E.). **A Comparison of Mosquitoes captured with avian Bait and with human Bait.**—*Proc. ent. Soc. Wash.* **47** no. 8 pp. 252–256, 13 refs. Washington, D.C., 1945.

Extensive mosquito catches were made at three vegetational levels with avian bait and on the ground with human bait in forest in two localities in Rio de Janeiro in 1942 and 1943 [*R.A.E.*, B **34** 9]. The characteristics of the localities and the methods used are described. The numbers of mosquitos of the genus *Culex* and of 18 species of other genera taken on man and in traps with avian bait at ground level, and the ratios between them, are shown in a table. These ratios indicate the existence of great variations in feeding preferences between the species and even between species within the same genus.

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GARNHAM (P. C. C.). **The Rôle of *Anopheles pharoensis* Theobald in the Transmission of Malaria in Kenya Colony.**—*Ann. trop. Med. Parasit.* **39** no. 2 pp. 63–65, 7 refs. Liverpool, 1945.

Anopheles pharoensis, Theo., is of some importance as a vector of malaria in Egypt [*cf. R.A.E.*, B **27** 137, etc.] and the Sudan [**20** 77] and has been found infected in Uganda [**20** 279], the Belgian Congo [**32** 88] and Southern Nigeria [**20** 65], but not in Northern Nigeria [**19** 31] or Kenya. It is sporadically distributed in Kenya, where it is found in large numbers in the swamps around lakes and is apparently confined to altitudes between 2,000 and 5,000 ft. It breeds throughout the year in overgrown drains and streams near Kisumu, and shows a well-marked increase associated with the long rains of April and May and sometimes one associated with the short rains later in the year. It comprises 0·7–4 per cent. of the total Anopheline day catches in huts and nearly 10 per cent. of the night catches. The period of maximum entry into huts is probably between midnight and dawn [*cf.* **30** 182]. Dissection of 1,334 females collected in huts for sporozoites and 33 for oöcysts gave negative results, which cannot be attributed to shortness of life before dissection or failure to feed on man. Infection rates for *A. gambiae*, Giles, and *A. funestus*, Giles, at the same time were 4 and 3 per cent., respectively. The maxillary index of Kisumu specimens of *A. pharoensis* was found to be 14·6, which suggests that the species as found there is primarily zoophilous though it sometimes feeds on man [*cf.* **20** 262; **30** 183], and the gut may be unsuitable for the sporogonic cycle of a parasite of human malaria. Moreover, the temperature may be too low for the continuous development of *Plasmodium falciparum*. It is suggested that in countries such as Egypt, where *A. pharoensis* is a vector, a variety and not the typical form of the species may be concerned [*cf.* **33** 204].

WOLMAN (B.) & WOLMAN (M.). **Studies of the biological Properties of *Spirochaeta recurrentis* in the Ethiopian High Plateau.**—*Ann. trop. Med. Parasit.* **39** no. 2 pp. 82–93, 27 refs. Liverpool, 1945.

This paper includes accounts of experiments on the cultivation of the spirochaetes that cause relapsing fever at Addis Ababa, the effects of ultra-violet rays on them, the infection of experimental animals and insect transmission. Relapsing fever is transmitted by lice [*Pediculus humanus*, L.] in this region [*R.A.E.*, B **27** 129; **30** 139]. An attempt to infect bed-bugs [*Cimex*] by allowing them to feed twice on the same day on a person ill with relapsing fever and then keeping them in a box at room-temperature without further feeding for up to 21 days was unsuccessful. The spirochaetes disappeared within 24 hours and did not reappear [*cf.* **26** 147]. Laboratory-bred lice were found to harbour visible spirochaetes every day for 18 days after being allowed to feed through fine wire netting for one hour twice in one day on patients showing heavy spirochaete infection and then being maintained by similar feeds on the authors. About 60 per cent. of the lice were infected. A negative phase in which the spirochaetes disappeared from all the lice was never found [*cf.* **3** 59; **25** 23]. The fact that neither of the authors became infected confirmed that the disease cannot be transmitted by the bite of the louse [**16** 58]. The offspring of infected lice did not contain visible spirochaetes, and mice could not be infected by them. No infection followed the injection of excreta of infected lice into mice. Lice fed on patients during an interval between two pyrexial attacks did not become infected.

The spirochaetes lived and multiplied in cultures over very wide ranges of temperature (0–45°C. [32–113°F.]). The authors consider this an indication that louse-borne spirochaetes are phylogenetically derived from tick-borne ones [*cf.* **16** 51]. The classification of relapsing fever spirochaetes is discussed in the last section. The authors incline to the view that they are not all of the

same species, but consider that immunological methods of classification are misleading [*cf.* **31** 44 176], as the antigenic properties of the organisms are not constant qualities but rather " potential variants ". The place of the spirochaete of the Ethiopian plateau in the subdivision of strains of the louse-borne spirochaete (*Spirochaeta recurrentis*) is not clear. It is apparently different from the North African strain that Nicolle & Anderson included in a study already noticed [**16** 18]. This could be transmitted to guineapigs and rabbits, whereas the Ethiopian strain could not, unless the reticulo-endothelian system was blocked. On the other hand, the Ethiopian strain, like the Chinese one, lacks an invisible phase in lice [**25** 23] and apparently cannot be transmitted by ticks [**25** 121 ; **27** 129].

CHWATT (L. J.). **The Morphology of the pharyngeal Armature in** *Anopheles gambiae* **and** *Anopheles gambiae* **var.** *melas* **from Southern Nigeria.**—*Ann. trop. Med. Parasit.* **39** no. 2 pp. 124–128, 3 figs., 12 refs. Liverpool, 1945.

To ascertain whether the pharyngeal armature would provide characters differentiating females of *Anopheles melas*, Theo., from those of *A. gambiae*, Giles, of which the author considers *melas* a variety [*cf. R.A.E.*, B **34** 138–139, etc.], 60 specimens from the coastal belt of Southern Nigeria were examined. Of these, 35 were identified from the morphology of the eggs as *gambiae* and 25 as *melas*. The technique used is described. No determinable and constant differences were found between the pharyngeal armatures of the two forms. The range of individual variation in structural details was extremely small. The structure as observed in these studies is described in some detail.

PRYOR (M. G. M.). **On the hardening of the Ootheca of** *Blatta orientalis*.—*Proc. roy. Soc.* (B) **128** no. 852 pp. 378–393, 28 refs. London, 1940.

The following is the author's summary. The series of reactions concerned in the hardening and darkening of the ootheca of *Blatta orientalis*, L., have been studied in the hope that they may throw some light on the hardening of the cuticle of insects in general. The ootheca is secreted by two glands, of which one secretes a water-soluble protein, and the other a dihydroxyphenol. After secretion, the phenol is oxidised, probably by an enzyme, to the corresponding quinone, which then combines with the protein by a reaction similar to that involved in the tanning of collagen by benzoquinone. This results in the introduction of primary valence cross-linkages into the protein net-work, so that it becomes rigid and very resistant to most chemical reagents and enzymes. The protein of the mature ootheca is more stable than keratin, and represents a new type of scleroprotein for which the name " sclerotin " is proposed.

PRYOR (M. G. M.). **On the hardening of the Cuticle of Insects.**—*Proc. roy. Soc.* (B) **128** no. 852 pp. 393–407, 1 pl., 28 refs. London, 1940.

The following is taken from the author's summary. The hardening of the insect cuticle, which was studied chiefly in larvae and pupae of *Ephestia kuehniella*, Zell., and puparia of *Calliphora erythrocephala*, Mg., is due to the formation of a protein similar to that of the cockroach ootheca [see preceding abstract]. A water-soluble protein and a dihydroxyphenol are secreted into the outer layers of the cuticle, and oxidation products of the phenol there react with the protein to form sclerotin. A similar reaction takes place in the epicuticle, which is secreted as a protein membrane and is subsequently " tanned " by the introduction of aromatic cross-linkages. After it has been converted into sclerotin in this way, the epicuticle is impregnated with lipids, which oxidise and polymerise until they become insoluble in fat solvents. The phenol that takes part in the reaction to form sclerotin is probably

dihydroxyphenyl-acetic acid, or some very similar compound ; the phenol in the blood, which is responsible for melanosis after death or at the site of injuries, will not react with protein *in vitro*, and so cannot be directly concerned in the formation of sclerotin. The blood phenol appears to be dihydroxyphenyl-alanine, which is transported in the blood from some organ where it is synthesised to the cells of the hypodermis, where it is deaminated and converted to the phenolic component of sclerotin.

DENNELL (R.). **Insect Epicuticle.**—*Nature* **155** no. 3940 p. 545, 7 refs. London, 1945.

Some insects are affected by an inert dust that adsorbs the epicuticle wax film [*R.A.E.*, A **33** 157] and others by a powder that abrades it [**33** 188], but it was found that larvae of *Sarcophaga* are affected by neither. Histological examination of the cuticle showed that lipoid substances are confined to a very thin layer on the surface of a thin (4μ) protein epicuticle. This surface layer, unlike the rest of the cuticle, is insoluble in cold concentrated hydrochloric acid and can therefore be isolated by this means. Since it is still stained by Sudan Black B [a fat stain] after prolonged treatment with lipid solvents, it is considered to be a constituent layer of the cuticle and to consist of a very stable lipo-protein complex. The bulk of the protein epicuticle does not stain readily with Sudan Black B and is almost completely untanned [see preceding abstract]. A similar double epicuticle is present in *Periplaneta*, which also possesses an external layer of labile fatty substance. Lipoids may thus be associated with insect cuticle in one or more of a number of ways. They may be present as a readily removable surface layer ; they may form a complex with the surface of the epicuticle so as to produce a distinct structural layer ; and they may impregnate the whole of the epicuticle when this layer is tanned. These variations in distribution must influence the effectiveness of inert dusts against different insects.

ULLYETT (G. C.). **Species of *Lucilia* attacking Sheep in South Africa.**—*Nature* **155** no. 3943 pp. 636–637. London, 1945.

Lucilia cuprina, Wied., is regarded as the main primary fly initiating blowfly infestation in living sheep in South Africa [and Australia (*R.A.E.*, B **26** 81, etc.)], where *L. sericata*, Mg., which is the chief cause of strike in Europe [*cf.* **31** 150], is not considered to be of importance. Both flies breed in carrion and occur in wounds in living sheep, and their systematic separation depends mainly on the colour of the femur of the fore-leg, which is bright green in *L. cuprina* and black in *L. sericata* ; the abdomen of *L. cuprina* is bronze-green and that of *L. sericata* is blue-green. The author points out that colour can vary with the larval food-supply and that flies showing gradations of colour in both femur and abdomen occur in field collections containing both species. The two flies interbreed readily in the laboratory [**21** 247]. In experiments in South Africa, the F_1 generation from crosses made in both directions comprised fertile individuals in which the femur was green and the abdomen blue-green. In the F_2 generation, the typical *cuprina* coloration, the F_1 coloration and the typical *sericata* coloration appeared in an approximate ratio of 1 : 4 : 1, which is the ratio for a Mendelian character with tetraploid characteristics. The author therefore considers that these flies cannot legitimately be separated by colour and that, if no other character can be found, they should be regarded as forms of one species. Flies with the coloration typical of hybrids always occur in field collections, and, as they have a green femur, they have probably been regarded as *L. cuprina*, which in consequence appears to be more abundant than *L. sericata*. It is more likely that the two typical forms are present in approximately equal numbers.

BUSVINE (J. R.). **Insecticidal Action of D.D.T.**—*Nature* **156** no. 3954 pp. 169–170, 4 refs. London, 1945.

The remarkable insecticidal power of DDT has been attributed to the combined action of a toxic component and one conferring lipoid solubility, but some consider the linked parachlorbenzene rings to be the toxic component and the chloroform residue to be responsible for solubility [*R.A.E.*, B **33** 76], whereas others suggest that the chlorbenzene rings confer lipoid solubility and that the rest of the molecule is responsible for toxicity by liberating hydrogen chloride at the vital centres [A **34** 255]. In order to investigate these theories, DDT and several analogous compounds were compared by determining their toxicities to *Cimex lectularius*, L., and *Pediculus humanus*, L., when applied as sprays in white oil, their rates of hydrolysis measured as the percentages of molecules from which HCl had been split off in a given time, and their solubilities in olive oil and white oil. The results are given in a table. DDT was the most toxic to both insects and was also the most rapidly hydrolysed, and indications were obtained of an inverse relationship between the toxicity of the compounds and their solubility in oils. The higher toxicity of the less soluble compounds might be explained by their higher degree of saturation in the carrier, and hence in the cuticular waxes and lipoids in contact with it, but if so, it would be expected that some of the differences in toxicity would disappear if the compounds were used as dry films or saturated solutions. When, however, *P. humanus* was confined on filter paper impregnated with saturated solutions of the compounds in white oil, they showed the same order of toxicity as in the spray experiment, and the times required for 50 per cent. mortality differed widely. The author concludes that the data so far available are insufficient for the formulation of a theory explaining the action of DDT.

HURST (H.). **Enzyme Activity as a Factor in Insect Physiology and Toxicology.**—*Nature* **156** no. 3955 pp. 194–198, 13 refs. London, 1945.

The toxicity of an insecticide may be related not only to its molecular structure, but also to the carrier in which it is dissolved, since this may alter the permeability of the insect cuticle and modify access to internal tissues [*R.A.E.*, A **34** 85]. The importance of this rate factor in access becomes apparent on the valid assumption that insecticidal activity is associated with some disturbance in the consecutive vital processes that regulate the dynamic balance in the internal tissue metabolism [B **33** 131]. The identification of biological responses such as paralysis or death with specific changes in enzyme activity would assist in the elucidation of the mode of action of compounds in which there is no apparent coincidence between molecular structure and insecticidal activity.

These concepts are illustrated in the present paper in which are defined the bio-physical factors that influence the uptake of insecticides by the cuticle and internal tissue receptors (a term used to indicate sites of action in biological systems with which drugs are supposed to combine or exert specific actions). Some new factors in insecticidal activity are described, depending on the discovery that the oxidation by enzymes of phenols in the cuticle and sensitive tissue receptors may be greatly modified by the selective environmental influence of the structural components associated with the enzymes *in vivo*. Narcosis, or knock-down action, may involve the indirect blocking of enzyme activity by the adsorption of the insecticide on the protective lipo-protein components of the tissues. Lethality usually involves an irreversible increase in the phenoloxidase activity, owing to the displacement of protective lipoid from the tissue receptor complex. This stage is accompanied by the accumulation of toxic quinonoid metabolites in the blood and tissues, and is characteristic of the lethal action of insecticides and the simpler fat-soluble drugs. The

similarity of action of DDT and the pyrethrins, which differ completely in molecular structure, is unlikely to be related to primary insecticide and tissue combination, but may indicate a coincidence in the dynamic chain of metabolic changes initiated at different links in the chain. The relative susceptibility of insects to contact insecticides depends partly on the permeability of the cuticle, but more fundamentally on the stability of the internal tissue receptors that regulate the internal balance in oxidative metabolism.

TOMLINSON (T. G.). **Control by D.D.T. of Flies breeding in percolating Sewage Filters.**—*Nature* **156** no. 3964 pp. 478–479, 1 graph. London, 1945.

The substances that have so far been used [*cf. R.A.E.*, B **34** 106] for the control of flies (principally *Anisopus fenestralis*, Scop., *Psychoda alternata*, Say, and *P. severini*, Tonn.) breeding in percolating sewage filters near dwellings or roads are not selective, and concentrations lethal to the fly larvae kill other members of the scouring population, such as Collembola and Enchytraeid worms, as well as bacteria and fungi, which form the active biological film. In test treatments of small experimental filters with DDT applied as a powder at 300 lb. DDT per acre and as an emulsified solution in naphtha or kerosene at 50–100 lb. DDT per acre, more than 90 per cent. of the larvae of *Anisopus* and *Psychoda* were killed, but the Collembola and worms were not affected. Preliminary tests also showed that DDT at these concentrations is not toxic to the bacteria and fungi. The results of a large-scale experiment made near Birmingham in April 1945, in which filters were treated with creosote at 400 gals. per acre, bleaching powder [chloride of lime] at 6½ tons per acre and DDT in an emulsion at 75 lb. DDT per acre, are given in a graph. Creosote caused the greatest reduction in numbers of *Anisopus*, but all the scouring organisms were killed and the biological film that accumulated supported a secondary population of *Psychoda*. Bleaching powder caused the biological film to be discharged from the filter, and later there was a secondary peak in the emergence of *Anisopus*. The numbers of both *Anisopus* and *Psychoda* were greatly reduced by DDT, and an active population of worms and Collembola remained and kept the growth of biological film in check.

COHEN (M.). **Experiments with D.D.T. Smokes.**—*Ann. appl. Biol.* **33** no. 1 pp. 125–126, 1 ref. London, 1946.

Experiments are described in which paper was impregnated with DDT and burnt to produce smoke, the toxicity of which was tested against flies, mosquitos and other insects [*R.A.E.*, A **35** 211]. Blotting or filter paper was soaked in an acetone or benzene solution of DDT, dried, soaked in a 5 per cent. solution of potassium nitrate to ensure even smouldering and re-dried at 50°C. [122°F.]. The prepared paper was ignited in a closed cylinder measuring 18 cm. by 4 cm. by contact with an electrically heated resistance wire. A heavy smoke, almost all of which settled in 20 minutes, was produced. Samples of smoke taken up in benzene that was then evaporated gave a crystalline residue with the same melting-point as DDT. *M[usca] domestica*, L., *F[annia] canicularis*, L., *S[tomoxys] calcitrans*, L., and *Culex* spp., subjected to the smoke in the cylinders were all knocked down in 5 seconds. *Musca* and *Fannia* remained motionless until the fumes had almost all settled, then uncoordinated leg movements occurred and the flies died several hours later. Smoke from paper impregnated with potassium nitrate only was not insecticidal.

A deposit of minute droplets formed on glass held over smouldering paper impregnated with DDT ; when stroked with a camel-hair brush or the feet of insects, it behaved like a supersaturated solution, the tracks being marked by the formation of crystals. Two adults of *F. canicularis* and one of *S. calcitrans* placed in a cylinder having an internal area of 276 sq. cm., in which the fumes

produced by burning paper bearing 0·13 mg. DDT had settled, were all knocked down in 20 minutes. After 16 days, this deposit knocked down *F. canicularis* in 22 minutes. Another cylinder was treated by burning a paper impregnated with 2·7 mg. DDT, and one adult of *F. canicularis* and two of *M. domestica* were introduced when the fumes had settled. *F. canicularis* was knocked down in nine minutes and *M. domestica* in 17–19 minutes. The residue was still lethal to flies after 16 days. On the hypothesis that no DDT is lost in combustion, 0·01 mg. was present per sq. cm. of cylinder wall.

To investigate the deposits obtained in practical fumigation, an outbuilding measuring $5\frac{1}{2} \times 4 \times 6$ ft. was fumigated by burning 9 sq. ft. of paper bearing 2·5 gm. DDT per sq. ft. The paper was in 20 sheets set upright on the floor 1 ft. apart. After the fumes had settled, sheets of glass previously placed on the walls, floor and ceiling and on a bench, were removed for analysis. The heaviest deposits were found on horizontal surfaces or near the floor, the average being 17·7 mg. per sq. ft.

STEER (W.) & COGHILL (K. J.). **The Control of Flies in Farm Buildings by D.D.T.** —*Ann. appl. Biol.* **33** no. 1 pp. 126–127. London, 1946.

Preliminary trials by Burgess in 1943 indicated that *Stomoxys calcitrans*, L., could be controlled in farm buildings by spraying inside walls with 1 per cent. Guesarol. Guesarol contains 5 per cent. DDT. In 1944, detailed tests were made in Cheshire in two adjoining identical brick farm buildings measuring $60 \times 33 \times 9$ ft., in each of which 25 cows were milked daily. Records of fly population in each building were taken up to five times daily on a selected stall, on a skylight, per bucket and per sq. yard of wall, and the number of dead flies swept up in the feeding passages was also recorded. The counts for 31st July and 2nd–9th August are given in a table. The preliminary counts established that infestations in the two buildings were similar. The flies present were mainly *S. calcitrans*, with *Fannia canicularis*, L., second in abundance. The whole interior of the western building was thoroughly sprayed with 2 per cent. Guesarol on 4th August, about 1 gal. per 30 sq. yards being used. The fly population was subsequently much lower in the sprayed than in the unsprayed building, but there were wide daily fluctuations reflecting weather conditions. Activity was favoured by warmth and sunshine. In 1945, the eastern building was treated. The number of flies dying in the western one, untreated in 1945, was three times the corresponding figure for 1944, suggesting that the deposit applied 14 months before still retained some toxicity. It is estimated that a mean of 200 flies per cow was brought in daily throughout the two years' trials. Very few were taken out except individuals of *Siphona* (*Lyperosia*) *irritans*, L., which never leave a cow to settle on walls. Owing to this reinforcement of population, the DDT treatment did not entirely prevent worrying of the cows, but it lessened it considerably. A subsidiary trial suggested that DDT applied mixed with whitewash was equally successful in making the walls toxic to flies.

CRAGG (J. B.). **The Control of Sheep Blowflies by D.D.T. Dips.**—*Ann. appl. Biol.* **33** no. 1 pp. 127–129, 4 refs. London, 1946.

Promising results having been obtained against *Lucilia sericata*, Mg., in 1944 with a sheep dip (M21) containing 0·5 per cent. DDT [*R.A.E.*, B **35** 78–79], further tests with a similar dip (M42) were made in North Wales in 1945, principally on Welsh mountain or improved Welsh sheep. Control flocks, similar in numbers, breed and sex of sheep, were treated with a proprietary (arsenic-sulphur) dip. The immersion time was 30 seconds. Observations

were continued for six weeks in four experiments and for four weeks in the fifth. The numbers of strikes recorded were 55 on 1,055 control sheep and 14 on 1,061 sheep dipped in DDT. Strike first occurred three days after dipping among controls and 23 days after dipping in DDT. Egg batches of *L. sericata* placed in wool that had been dipped in 0·5 per cent. DDT hatched, and some of the larvae established themselves on meat. Contact for 24 hours at 34°C. [93·2°F.] with such wool had no immediate lethal effect on most third-instar larvae, but although such larvae could pupate, no adults emerged. Though prolonged exposure to DDT may be highly toxic, larvae feeding on the flesh of sheep are on a surface that should be free from DDT. The occurrence of dead larvae in strikes on sheep that have been treated with DDT may be the result of larvicidal action, but it could also be the result of a reduction in oviposition through the action of the DDT on the female flies, as small strikes tend to dry out and some larvae would be killed by desiccation. The carcass of a sheep that had been dipped with DDT six weeks before death was found to be very slowly colonised by larvae, though highly attractive to blowflies. Many dead flies surrounded it, and comparatively few egg batches were found on it in the five days following death.

The effectiveness of DDT over the concentration range of 0·1–0·75 per cent. (emulsion M42) was tested in Cumberland by using attractants on the sheep and counting the number of egg batches laid in the region of the pad [*cf.* **26** 7]. With both 0·1 and 0·25 per cent., some egg batches were laid, though less than on controls dipped in a proprietary arsenical preparation, and the figures indicate that, with the type of emulsion tested, 0·5 per cent. DDT is probably the lowest concentration suitable for use on a field scale.

As the protection given against strike by the DDT dips was not complete, other control measures, particularly crutching [*cf.* **34** 97, etc.] should be advised in conjunction with them. The sheep in the Welsh experiments had not been crutched, and 64 of the 69 strikes recorded were in the region of the tail. Although DDT has little immediate larvicidal action, it should be useful in dressings to reduce the incidence of re-strikes. Whereas with the existing dips very good penetration of the fleece is essential to kill the larvae, the aim with DDT should be to provide a good surface covering that will be toxic to the ovipositing flies. DDT could therefore be applied by sprays or jets instead of by dipping.

SHAW (H.). **Some Uses of D.D.T. in Agriculture.**—*Nature* **157** no. 3984 pp. 285–287, 3 refs. London, 1946.

This is an account of papers read at a meeting of the Association of Applied Biologists on 5th October 1945, some of which are noticed above [see three preceding abstracts]. G. B. S. Heath and J. G. Mitchell reported field trials of emulsions containing DDT against *Ixodes ricinus*, L., on hill farms in Cumberland, where there is a major peak of infestation in April–May and a minor one in August–September [*cf. R.A.E.*, B **33** 165–166]. More than half the ticks on the animals were on the ears and face. There were few in the fleece proper. A commercial arsenical dip that reduced infestation significantly for only about 14 days was used as control. A dip containing 0·5 per cent. DDT gave good protection against ticks for seven weeks, and one containing 0·3 per cent. for four weeks. The concentration of DDT in the fleece exceeded 1 per cent., and the bath was rapidly exhausted. When the experiment was repeated with a similar but not identical emulsion, protection was no better than in the control group, and the concentration of DDT in the fleece did not exceed that in the bath, which did not fall appreciably during dipping. The first emulsion was much the less finely dispersed, and further work showed that this was the principal factor determining deposition on the fleece and consequent effectiveness. In ordinary anionic emulsions, the oil globules show no affinity for the

fibre, but in cationic emulsions, they are strongly attracted. Pre-treatment of the fleece with dilute acetic acid reverses these affinities. In field trials, heavy deposits and good protection generally followed dipping in coarse anionic emulsions, in fine anionic emulsions after swabbing heads and axillae with acetic acid, or in a cationic emulsion. A cationic dip containing only 0·2 per cent. DDT was effective. Spraying did not wet the fleece, but jetting at 150 lb. pressure did. The effect of DDT on keds [*Melophagus ovinus*, L.] was even greater than on ticks [*cf.* **35** 71].

LEWIS (D. J.). **General Observations on Mosquitos in Relation to Yellow Fever in the Anglo-Egyptian Sudan.**—*Bull. ent. Res.* **37** pt. 4 pp. 543–566, 3 maps, 39 refs. London, 1947.

People immune from yellow fever have been found in many parts of the southern half of the Sudan [*cf. R.A.E.*, B **29** 115 ; **32** 110] and a severe epidemic of the disease occurred in the Nuba Mountains in 1940 [**29** 115 ; **30** 88]. In view of this and the fact that the country is crossed by important air, rail and water routes to uninfected areas, information on the common mosquitos of the Sudan is surveyed, supplementing that already published on bionomics in relation to yellow fever [**32** 24] and distribution and taxonomy [**34** 188]. Little reference is made to breeding places, because the subject was fully dealt with by Hopkins [**24** 123], and Anophelines are only very briefly considered, as they appear unlikely to transmit yellow fever. The species dealt with at greatest length are *Mansonia* (*Taeniorhynchus*) *africana*, Theo., *M.* (*T.*) *uniformis*, Theo., and *Aëdes aegypti*, L., including its variety *queenslandensis*, Theo. Lists are given of the 12 mosquitos found in the Sudan that are known to be able to transmit the disease by biting, including *M. africana* [**18** 147], *A. aegypti* and var. *queenslandensis* [**31** 21], and of the two able to retain the virus throughout life though apparently unable to transmit it, including *M. uniformis* [**20** 221], and the two that can retain the virus for a short time only. The authorities are shown in all cases. Observations on the biting habits of some mosquitos in relation to man in the Sudan are summarised in a table. Notes are then given on the mosquitos of each of some 20 natural areas of the Sudan, which are sub-divisions of the recognised faunal areas.

To prevent the spread of yellow fever, potential mosquito vectors are controlled in towns and villages along lines of communication, so that any infection introduced by an infected man or mosquito is likely to die out. Trains are sprayed in the rainy season before they reach Khartoum and Port Sudan. Steamers are sprayed en route by their crews and inspected by public health staff at the principal stopping places. Aircraft that fly northwards or eastwards from the Khartoum area or northwards from Port Sudan are sprayed. It is thought that the measures in force have made urban epidemics with *A. aegypti* as the vector impossible, virtually exterminated *A. aegypti* from Khartoum, greatly reduced the number of mosquitos, particularly those with domestic breeding habits, carried on steamers, and made the chance of yellow fever spreading north very slight. The maintenance of these measures is therefore very important. In most places, the control of a rural epidemic would be extremely difficult.

RIBBANDS (C. R.). **The Use of residual Films of DDT and Gammexane in Malaria Control.**—*Bull. ent. Res.* **37** pt. 4 pp. 567–592, 4 figs., 13 refs. London, 1947.

This report on experiments made in coolie huts in Assam between March and December 1945, to determine optimum methods of using film deposits of DDT

or benzene hexachloride for the control of adult mosquitos is divided into three parts. Tests of the merits of various types of apparatus for applying sprays to leave a toxic residue are described in the first. It was found that sprays atomised and mingled with air are wasteful in both material and labour. Knapsack oilers and modified stirrup pumps are efficient. Hand-operated sprayers of this type are more economical than motor-operated ones where labour is cheap. Because of the wide differences in efficiency of various types of sprayers, records of experiments with toxic residues should differentiate between the quantity of spray used and the quantity likely to have adhered to the sprayed surface.

The relation between mosquito control and the elimination of malaria is discussed in the second section. The cumulative risk of death for female mosquitos entering treated houses to feed one, two, three, four or eight times within eight days (the minimum known incubation period for the malaria parasite in the mosquito [*cf.* *R.A.E.*, B **33** 136]) at different rates of risk per entry is shown in a table. The minimum effectiveness of the insecticide deposit necessary to prevent completely the transmission of malaria depends on the house-haunting habits of the vector concerned, but any treatment with an initial effectiveness of 75 per cent. should give complete control over the period of development of the parasite. It is pointed out that, as Anophelines are extremely local in their habits, one badly treated dwelling close to a breeding ground may be visited several times by the same female and eventually become a focus of infection. Also, there may be races of individuals with less marked preference for indoor feeding and sheltering than is usual in the species, and these would be less exposed to risk. However, these two factors should be more than offset by others tending to decrease the risk of transmission. Some mosquitos do not become infected at their first blood-meal. Most live for a short time, and some of the few that survive long enough to become infective might live until they had obtained several infective feeds [**31** 169], the hazard of death increasing with each feed. Some females of *Anopheles minimus*, Theo., enter dwellings for shelter only on nights when they do not feed. Females might acquire several sub-lethal doses of poison that would accumulate to a lethal dose. The effect of destroying females may be cumulative through the reduction of larval production. A considerable decrease in malaria transmission should reduce the human malaria reservoir, and so decrease the risk of mosquitos acquiring infection.

In the third section, the author deals with the effects of the various treatments tested. The sprays were applied with a stirrup pump with a spinner nozzle held about 18 ins. from the surface to be treated. About 75 per cent. of the dose would adhere to the surface under these conditions. The dosages given are those used, not those adhering. The DDT was commercially pure (para para content about 80 per cent.), and the benzene hexachloride was a crude sample containing 12 per cent. of the active γ isomer (gammexane). DDT was used either in solution in kerosene or in an emulsion, which, in its undiluted form, had the formula 220 gm. DDT, 586 gm. medium kerosene extract, 39 gm. bar soap and 155 gm. water. The benzene hexachloride was used either in solution in the kerosene extract or in an emulsion similar to the DDT emulsion, but containing 7 per cent. benzene hexachloride. Medium kerosene extract is a cheap by-product of the refining of kerosene and its very high aromatic content makes it an extremely efficient solvent for both DDT and benzene hexachloride. The mosquitos involved are divided into three groups. These are *minimus* (comprising 60–80 per cent. *A. minimus*, with the balance composed of *A. varuna*, Iyen., and a few individuals of *A. fluviatilis*, James, and *A. aconitus*, Dön.), *vagus* (comprising 95 per cent. *A. vagus*, Dön., 5 per cent. *A. annularis*, Wulp, and occasional individuals of other species) and Culicines (comprising a considerable variety of unidentified species).

The results are given for females of *minimus* and all adults of the other groups, but no differences in effect between sexes were noted.

When applied to cover the whole of the inside wall and roof surface of the hut and any furniture in it, all treatments were effective in that they reduced the numbers of mosquitos by over 90 per cent., but the duration of effectiveness varied with the treatment and the group of mosquitos. The effects of DDT used in emulsion were much more lasting than those of a similar quantity of DDT in kerosene solution. When used at 1 quart per 200 sq. ft., the standard rate of application and the one used in all the tests noticed below, 1·25 per cent. emulsion was effective for 20 weeks against *minimus*, but 5 per cent. solution was required for an equal result, and at smaller concentrations the emulsion remained effective more than twice as long as the solution. The emulsions were effective for at least four times as long as the solutions against *vagus*. More contradictory results were obtained against Culicines, but the emulsions were generally better. The possible reasons are discussed. The difference between emulsion and solution was much less marked with 5 per cent. benzene hexachloride. The duration of effectiveness of DDT was markedly enhanced by increased concentration, so that it will be most economical to apply DDT in heavy doses at long intervals. Concentrations of DDT effective for 20 weeks were 5 per cent. in solution against *minimus* and Culicines, 1·25 per cent. in the emulsion against *minimus* only and 5 per cent. in the emulsion against Culicines. Concentrations effective for 10 weeks were 1·25 per cent. in solution or 0·625 per cent. DDT in emulsion against *minimus*, and 2·5 per cent. in emulsion against *vagus* and Culicines. The persistence of the effect of benzene hexachloride was not greatly increased by increasing dosage from 0·625 to 5 per cent. because it evaporated much more quickly than DDT. It is not likely to be effective for more than 10 weeks. Treatments with DDT were usually effective against *minimus* for about twice as long as against *vagus* or Culicines, but treatments with benzene hexachloride had similar effects on all groups.

Extensive reductions in mosquito infestation, probably to some extent attributable to repellent and temporary toxic effects [see next abstract], were produced by various partial treatments with DDT and benzene hexachloride. Treatment of either ceilings [*cf.* **30** 170] or walls only with 5 per cent. DDT in kerosene reduced *minimus* infestation by 90–95 per cent. for 19–20 weeks. Temporary reduction in *minimus* infestation (by about 90 per cent.) was secured by applying bands of solution containing 5 per cent. DDT or benzene hexachloride to the eaves only of huts (either inside or outside). Experiments with heavier concentrations of insecticide may prove this to be the most economical method of treatment. Treatment of only the exterior walls and eaves of huts reduced *minimus* infestation by more than 90 per cent. for 20 weeks. Reduction of *vagus* and Culicines was apparently about 50 per cent. but this was not necessarily significant. Now that it has been shown that DDT deposits have excitant and temporarily toxic effects, the aim of treatments should be to ensure that surfaces are covered heavily enough for mosquitos alighting once to acquire a lethal dose before they become excited. This is most likely to be accomplished by applying very heavy doses to restricted areas in accordance with the methods of partial treatment described. Treatments suggested for extensive trials are applications of 5 per cent. DDT or benzene hexachloride in emulsions at 1 quart per 200 sq. ft. to the whole interior surface of huts or to ceilings or walls only, and of 5 or 10 per cent. benzene hexachloride or 5, 10 or 20 per cent. DDT to both external and internal eaves.

From observations on the results of partial treatments, it is inferred that *minimus* females usually touch the wall surface more than once. The results of the application of bands of insecticide to the eaves indicate that a very high proportion of *minimus* females and a considerable proportion of other mosquitos

touch this surface or alight on it as they enter the huts. There was circumstantial evidence that they usually rested on the outside walls or crawled over them before entering. Ceilings were attractive to *vagus* as well as to *minimus* but not to Culicines.

KENNEDY (J. S.). **The excitant and repellent Effects on Mosquitos of sub-lethal Contacts with DDT.**—*Bull. ent. Res.* **37** pt. 4 pp. 593–607, 1 fig., 14 refs. London, 1947.

The following is partly based on the author's summary. The signs of poisoning shown by *Aëdes aegypti*, L., after tarsal contact with DDT deposits are excitation, ataxia, convulsions and general paralysis, followed by death. Those shown by *Anopheles maculipennis* var. *atroparvus*, van Thiel, are similar, except that autotomy of the legs is common during ataxia and convulsions. It was repeatedly observed, however, that, contrary to widespread belief, mosquitos can recover after showing all the preliminary symptoms of DDT poisoning and this led the author to investigate the repellent effect of the chemical. The effect of contact with DDT on the activity and distribution of mosquitos was studied in a small cage, exposure times being kept below that necessary to cause death. The procedure used is described. The duration of single resting periods on DDT-treated surfaces was several times shorter than resting periods on untreated surfaces, provided that the mosquitos had had no recent access to DDT. Mosquitos that had been in recent contact with DDT rested only slightly longer on untreated than on treated surfaces. *Anopheles* was nearly always stimulated to flight [*cf. R.A.E.*, B **34** 129], but *Aëdes* also crawled. Mosquitos excited by DDT moved for preference towards light [*cf.* **34** 189] In the case of *Aëdes*, about half of those exposed in a central chamber from which they could fly to a light or a dark one left it whether it was treated or not, about half going to light if it was untreated and all if it was treated. Over 80 per cent. of *Anopheles* escaping from the experimental chamber went to light in both cases, but 65 per cent. escaped from the treated chamber and only 17 per cent. from the untreated one. The significance of these differences is discussed. The percentage of all tested mosquitos escaping to light increased from 24 to 54 among *Aëdes* and 15 to 53 among *Anopheles*. This preference for light might lead the mosquitos to leave a treated room and so escape a lethal dose.

Excitation by DDT rendered treated surfaces weakly or strongly repellent or even attractive, according to circumstances. The practical significance of this is discussed at some length with reference to the literature. It is suggested that the term repellency should be used only for the observed effects on distribution and not for reaction, and that repellency of the type that DDT can produce, based on delayed reactions not perhaps of a normal sensory nature, must be taken into consideration in the use of DDT deposits for mosquito control. Some examples are given to illustrate how the symptoms induced by sub-lethal doses influence the effectiveness of applications of DDT for other purposes, advantageously or otherwise according to the type of control the DDT is intended to exert. Thus, sub-lethal doses cause mosquito larvae to drown [**34** 173] and prevent blowflies from ovipositing on sheep [**35** 78–79] and so fulfil their object, but the excitation that leads to repellency may be disadvantageous if cattle are treated with a view to the control of tsetse-flies [*Glossina*] as although it prevents biting, it may allow the flies to survive to bite untreated game and reproduce.

Research may be needed on methods of retarding rather than accelerating the penetration of insecticide into insects. Thus, if an insect were made to acquire and retain a heavy external load of DDT from a dust of fine crystals or a film of slowly penetrating oil, this should not contribute towards immediate excitation,

but provide a reservoir from which DDT would continue to penetrate into the insect after it had left the treated surface.

GARNHAM (P. C. C.) & MCMAHON (J. P.). **The Eradication of *Simulium neavei*, Roubaud, from an Onchocerciasis Area in Kenya Colony.**—*Bull. ent. Res.* **37** pt. 4 pp. 619–628, 3 figs., 7 refs. London, 1947.

Onchocercosis [caused by *Onchocerca volvulus*] occurs in Kenya in the large Kaimosi-Kakamega Forest [*R.A.E.*, B **27** 267; **34** 93] and in three areas in South Kavirondo [**28** 209] and one in the Kericho District [**10** 16]. The vector is *Simulium neavei*, Roub. The exact breeding habits of this species are not known, but there was strong circumstantial evidence that the larvae were to be found in fast-flowing streams and rivers. In a preliminary trial of the action of DDT on the immature stages of Simuliids in January 1945, a stream near Nairobi was found to be completely free of larvae and living pupae of *S. elgonensis*, Gibbins, one and two weeks after an emulsified solution of DDT in kerosene had been allowed to drip into it to give two parts DDT per million parts water for 35 minutes. Larvae and pupae continued to be abundant above the treated stretch. This result was thought to justify a large-scale experiment on the elimination of *S. neavei*, and this was made at Kodera in South Kavirondo where nine miles of one river and six miles of another were infested. The area was 65 sq. miles in extent and was well isolated from the next focus of infestation.

The DDT emulsion first used was not made locally but this was later supplemented by other preparations, of which the best was a solution in toluene (20 per cent. of the para para compound) with 10 per cent. soap as emulsifier and 1 per cent. Abracol as a stabiliser. When supplies of toluene failed, a 10 per cent. para para solution in medium kerosene extract [*cf.* **35** 105] with 20 per cent. soap as emulsifier and stabiliser was adopted. The amount of DDT first applied was two parts per million parts water, but this was later increased to five parts or more. These amounts were applied to the water for 30 minutes at a time, ensuring contact between insecticide and larvae for this period. As the life-cycle has been variously estimated to last two weeks or two months, the first ten applications were made at intervals of ten days and later ones at intervals of a fortnight or eventually a month. Treatment had to be continued until it was certain that the last surviving fly had finished ovipositing. No exact data on length of adult life were available, but females probably do not live much longer than two months. Applications of DDT were made for five months (19th January to 22nd June 1946) for safety. Methods of measuring the flow of the water to calculate the necessary dosage are briefly discussed. The points of application were chosen so as to be well above the stretches of river providing optimum conditions (heavy shade, numerous waterfalls and a course eroded deeply below the surrounding ground) and above the upper limit of infestation. The emulsion was applied at a mill from tins suspended over the water course and having holes bored in the bottom to give a standard rate of delivery. It became thoroughly mixed with the water in the mill chase and again in the numerous cascades where breeding almost certainly occurs. The calendar of applications with dosages is given, and the methods of assessing the results are described.

Eleven days after treatment, immature stages of Simuliids (*Simulium alcocki*, Pomeroy, *S. lepidum*, De Meillon, and *S. elgonensis*) disappeared from all check stations except for one below a stagnant stretch of river, and none was found during the weekly searches that continued for the next five months. Large numbers were still being produced above the point of application. Neither a big increase in the concentration at the dosing point nor the additional introduction of DDT in the immediate vicinity had any effect on breeding near the stagnant stretch until heavy rain began and the rate of flow increased

considerably. The Simuliids disappeared almost immediately afterwards. The number of adults of *S. neavei* caught per month in the test area from January to December 1945 varied from 25 in April to 240 in December. The numbers taken in similar routine catches in 1946 were 27, 2 and 5 in January, February and March, respectively, and none thereafter until catches ceased in September. Very careful intensive searches also failed to reveal the presence of a single example from April to September. Observations in an infested area six miles away showed that there was no natural disappearance of the Simuliid at this time. Most forms of aquatic life other than *S. neavei* had returned to the treated streams three months after the last application.

The effect of the eradication of *S. neavei* on the incidence of onchocercosis will not be seen until a new generation of Africans grows up. In order to provide an index for future surveys, 79 children aged 4–8 years were examined ; 29 (37 per cent.) showed microfilariae. Of 14 children aged 3–4 years, only one was positive. For future use, the method of control would have to be modified in respect of the minimum lethal dose of DDT, the maximum interval between applications and the total period necessary to ensure eradication. Its disadvantages are the destruction of fish, the large quantities needed for large rivers and the difficulty of depositing DDT in slowly moving waters.

The adult mosquitos taken in the course of the intensive searches for *Simulium* in June and September 1946 are shown in an appendix. The only Anopheline was one male of *Anopheles gambiae*, Giles. The most abundant species were *Aëdes africanus*, Theo., and *A. apicoargenteus*, Theo.

[Pletnev (E. A.).] **Плетнев (Е. А.). Bloodsucking Mosquitos (Culicidae) of southern Kazakhstan.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 5–22, 16 refs. Alma-Ata, 1943. (With a Summary in English, p. 126.)

Malaria is common in Kazakstan, and mosquitos are troublesome pests of man and domestic animals in the irrigated zone and along rivers. A survey to ascertain the species present was carried out in 1926–29 in southern Kazakstan in the area between the town of Kopal in the east and the river Suir-Dar'ya in the west and up the basin of the latter from the border of Uzbekistan to the town of Kzuil-Orda. The character of the country is described, with special reference to the various types of water in which mosquitos bred, and notes are given on the local distribution, abundance, seasonal occurrence, breeding places and mode of hibernation of the 23 species and varieties collected. Of the Anophelines, *Anopheles hyrcanus* var. *pseudopictus*, Grassi, which was the commonest, bred in soft river water, lakes and swamps, and hibernated in the adult stage among reeds and fallen trees. Except for var. *sacharovi*, Favr, which was widely distributed, *A. maculipennis*, Mg., was not common. It bred in shallow water among pebbles, and hibernated in inhabited rooms, basements, cellars and animal quarters ; var. *sacharovi* bred in stagnant water and hibernated in animal quarters and uninhabited buildings and also among dense vegetation in gardens. *A. superpictus*, Grassi, which occurred near the mountains, bred chiefly in hard water among pebbles at the edges of springs, and hibernated in animal quarters and poultry houses and to some extent in dwellings. *A. claviger*, Mg. (*bifurcatus*, auct.) was found only in the mountains, where it bred in ponds, lakes and pits in gardens. It hibernated in the adult stage in clefts in ravines and among fallen trees, and probably also in the larval stage. *A. pulcherrimus*, Theo., was restricted to a single locality in the south-west, where it was the commonest Anopheline ; it bred in the smaller, slow-flowing irrigation ditches, and the larvae overwintered.

Comparative lists are given of the mosquitos of southern Kazakstan and of neighbouring parts of Asiatic Russia, and the faunistic affinities of the area are briefly discussed.

[Vel'tishchev (P. A.).] **Вельтищев (П. А.). Contribution to the Question of the Distribution of the Representatives of the Genus *Anopheles* (Diptera, Culicidae) in the northern Part of southern Kazakhstan.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 23–29, 10 refs. Alma-Ata, 1943. (With a Summary in English, p. 126.)

An account is given of investigations on the Anophelines of southern Kazakstan carried out in July–August 1937 near the town of Kazalinsk, on the upper Suir-Dar'ya, and in the village of Dzhulek, some 60 miles south of Kzuil-Orda, further down the river. *Anopheles maculipennis*, Mg., was common in the town, where it attacked man, and var. *sacharovi*, Favr, was the most numerous Anopheline in the village. The larvae and pupae of this variety occurred in many types of water and were commonest in rice-fields, and the adults congregated in dark corners in cattle sheds and stables. The females fed almost exclusively on cattle and horses, but rarely attacked them outdoors. Very few were observed in dwellings, and they did not attack man indoors, outdoors or in the animal quarters. In experiments in which some hundreds of unfed females were released in rooms in which many people were sleeping, they were recaptured in the morning in the same unfed condition, whereas 80–100 per cent. of those taken in a cattle shed near-by contained blood. *A. hyrcanus*, Pall., which readily attacked man, was the next in abundance in the village, but did not occur in the town. Only single adults were taken in animal quarters, and the majority concentrated on the windows and walls on the sunny side of houses. *A. algeriensis*, Theo., was rare but readily attacked man after sunset in woods in water meadows; six larvae were found in June among reeds in water with a temperature of 17·2°C. [63°F.]. Two engorged females of *A. pulcherrimus*, Theo., were taken on the railway station at Kazalinsk, and a few of *A. superpictus*, Grassi, along the railway line; both had probably been accidentally brought by train. *A. claviger*, Mg. (*bifurcatus*, auct.) was not found, though it had been recorded from the area previously. Observation showed that the adults of *A. algeriensis*, flew little more than half a mile from their breeding places while *A. m. sacharovi* and *A. hyrcanus* covered distances of up to 5 miles. Malaria was not epidemic in the areas surveyed and was rare in some parts.

[Andreev (L. A.).] **Андреев (Л. А.). Contribution to the Question of Sandflies and Sandfly Fever in the Province of Alma-Ata.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 30–33, 1 fig., 4 refs. Alma-Ata, 1943. (With a Summary in English, p. 126.)

Over 200 sandflies collected between 26th June and 12th August 1939 in houses in the town of Alma-Ata in south-eastern Kazakstan and in villages in adjoining foothills of the Alatau mountains were all identified as *Phlebotomus chinensis*, Newst. Three females kept in the insectary laid 23, 32 and 38 eggs, but none hatched. It is concluded from the numbers taken that adult sandflies are present in this region from mid-June to mid-August and most numerous in the first half of July. They attack man commonly, and probably not domestic animals, as they were not found in stables or cattle sheds. It is not known whether any disease transmitted by sandflies occurs in the area.

[Galuzo (I. G.).] **Галузо (И. Г.). Natural and potential Vectors of Theileriasis.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 41–47, 1 fldg. table, 49 refs. Alma-Ata, 1943. (With Summary in English, pp. 126–27.)

The author reviews the literature on the transmission to cattle by Ixodid ticks of the forms of piroplasmosis caused by *Theileria* and points out that experiments with particular Ixodids have not always given consistent results

and have not always been borne out by observations in nature. This may be due to the special conditions under which experiments are carried out. If these are favourable, the causal agent may complete its life-cycle in a tick that is not a natural vector. An experimental vector cannot be a natural one if its immature stages do not feed on cattle in nature, since the species of *Theileria* do not persist in ticks from one generation to the next, or if its geographical distribution or seasonal occurrence do not coincide with those of outbreaks of the disease. The conditions to be fulfilled before a given tick should be considered a natural vector are discussed, and a table is given in which data from the Russian literature on the transmission of *Theileria* are summarised with reference to them. It appears that of the many species included, only *Hyalomma detritum*, Schulze, and *H. savignyi*, Gerv., are natural vectors.

[Zotova (A. A.) & Bolditzina (K. S.).] **Зотова (А. А.) и Болдицина (К. С.). An Experiment in infecting Ticks with Brucellosis under Laboratory Conditions.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 48–49. Alma-Ata, 1943.

A first series of experiments was carried out with 52 females of *Hyalomma marginatum*, Koch, that engorged on guineapigs infected with brucellosis. Cultures of the stomach contents of 20 of them revealed the presence of *Brucella melitensis* in one tick. Suspensions of small batches of ticks, prepared immediately or 24 hours after engorgement, were injected subcutaneously into ten healthy guineapigs, and nine of these subsequently gave a positive reaction in serological tests. Cultures of their organs showed the presence of *Brucella* in five of them. When suspensions of larvae of *H. marginatum* that were the progeny of an experimentally infected female were injected into two healthy guineapigs, no serological reaction was obtained.

In similar experiments with 80 females of *H. savignyi*, Gerv., that had engorged on infected guineapigs, attempts to establish cultures of *Brucella* from 20 of them proved unsuccessful, but one of three healthy guineapigs into which suspensions were injected showed a positive reaction in serological tests.

[Galuzo (I. G.).] **Галузо (И. Г.). Data on the Ecology of *Boophilus calcaratus*.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 50–68, 5 graphs, 20 refs. Alma-Ata, 1943. (With a Summary in English, p. 127.)

The observations described were carried out in the Hissar Valley in western Tadzhikistan with a view to working out a system of control measures against *Boophilus calcaratus*, Bir., a one-host tick that chiefly attacks cattle, occurs less frequently on horses and other farm animals and has not been found on wild vertebrates. It was present in varying numbers on cattle throughout the year (except during the first ten days of February), but there are three distinct waves of infestation, in spring, summer and autumn [*R.A.E.*, B **35** 75]. Observations on the development in field cages of eggs laid by females at different times of the year and on the resulting larvae showed that most females that drop from their hosts in summer give rise to overwintering larvae and females that drop in autumn to overwintering eggs. The spring wave consists mainly of ticks that overwintered as larvae, the summer wave of ticks that hatch from overwintered eggs, and the autumn wave of ticks that hatch from eggs laid by the spring wave, but some of the ticks of the summer and autumn waves are the offspring of females that drop early in the spring and summer waves, respectively.

Observations on ticks in different environments showed that the number of generations produced in a year may vary from one to three and depends on environmental conditions, particularly the temperature to which the ticks are

exposed when off the host, and the availability of cattle for the newly hatched larvae. The damp low-lying parts of the valley are unfavourable for hibernation, because the eggs and larvae are killed by flooding in spring and autumn, but favourable for summer breeding, whereas the drier land that favours hibernation is unfavourable to the eggs in summer as it does not carry enough grass or other vegetation to shelter the eggs from excessive heat and lack of humidity.

The control measures recommended include mowing water meadows, the edges of irrigation ditches and old lucerne fields in July or August and removing the hay, to expose the soil to the sun ; disking and harrowing in meadows in summer to destroy undergrowth, and in autumn in non-irrigated pastures and waste land to destroy the hibernating eggs ; rotation of pastures ; grazing cattle in summer in the mountains at altitudes of about 3,000 ft., where the tick does not as a rule occur ; and dipping cattle and horses in 0·2 per cent. sodium arsenite every 8–10 days in summer.

[Galuzo (I. G.).] **Галузо (И. Г.). The Effect of physical Factors of the Environment on the Conditions of the Development of Ticks in Nature.** [*In Russian.*] —*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 85–96, 7 figs., 23 refs. Alma-Ata, 1943.

Since important phases in the life-cycle of Ixodid ticks occur off their hosts, their development in their natural habitats is closely related to the microclimatic conditions obtaining at the soil surface. The author shows by examples taken from the literature and his own observations in the Hissar Valley (Tadzhikistan) and southern Kazakstan how these vary with physical features, proximity to water, the nature of the soil, plant cover and certain factors associated with man, such as grazing of cattle, ploughing, mowing and irrigation. The fluctuations throughout the year in the temperature and relative humidity of some of the biotopes studied are shown on graphs. Each biotope has also its own peculiar day and night changes in microclimate. The conditions under which ticks occur in nature are thus very unstable, and they can be controlled by rendering their habitats unsuitable for development. The life-cycle of *Boophilus calcaratus*, Bir., is briefly outlined, and a general programme of agricultural measures designed to interrupt this cycle is given [*cf.* preceding abstract].

[Galuzo (I. G.).] **Галузо (И. Г.). The physical Conditions of the Development of Ticks on the Surface of the Body of the Host.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 97–105, 7 figs., 1 fldg. table, 4 refs. Alma-Ata, 1943.

With a view to explaining the distribution of Ixodid ticks on the bodies of their hosts, a study was made in the summers of 1935 and 1936 in Tadzhikistan and eastern Uzbekistan of the temperature of the skin of cattle and the factors that affect it. For this purpose, records were made by the thermo-electric method of the temperature on the surface of the skin, 2–3 mm. below the surface, and in the hair, the test animal being in a wooden platform in an open plot covered with grass. In one such test, when the air temperature was 23·5°C. [74·3°F.], direct exposure to the sun increased the temperature of the hair and skin on the back to 43°C. [109·4°F.], whereas protection from the sun reduced the temperature to 36°C. [96·8°F.] in the hair and 37°C. [98·6°F.] on and in the skin. This indicated that the hair absorbed and radiated the heat, and that the heating of the skin depended on the heating of the hair and of the air confined in it. White hair absorbed less heat than brown or black hair.

Observations on various Ixodids showed that each species and each stage attaches itself to a particular region on the host, and this distribution apparently depends on the temperature of the hair. Before attaching themselves, the ticks crawl about on the skin until they find a site that offers suitable temperature

conditions. Thus, larvae of *H[yalomma] detritum*, Schulze, which are on the animals in October–November, attach themselves to the parts of the body most exposed to the sun, whereas the adults, which are on the animals in June–July, attach themselves on the under parts. *B[oophilus] calcaratus*, Bir., tends to congregate in spring and summer on the dewlap of cattle and in autumn on the more exposed parts of the neck and sides and even on the tail. Examples of *Dermacentor* that were placed on a shorn sheep under an overall in the evening attached themselves to the back, but during the day, when the sun heated the skin, they migrated to the abdomen and chest.

[Rodionova (N. F.).] **Родионова (Н. Ф.). The Use of Desinsectalin for the Control of Ectoparasites of Animals.** [*In Russian.*]—*Izv. kazakh. Fil. Akad. Nauk* (Ser. zool.) no. 2 pp. 79–84, 3 refs. Alma-Ata, 1943. (With a Summary in English, p. 127.)

As the use of dips or washes for the control of Arthropod parasites of domestic animals is unsafe during the winter, experiments with desinsectalin were carried out at Alma-Ata in southern Kazakstan. The name desinsectalin is applied in Russia to various mixtures of crude naphthalene with sawdust, sand or coal dust [*cf.* also *R.A.E.*, B **34** 119]; a coal-dust preparation containing 40 per cent. naphthalene and 60 per cent. coal with an admixture of neutral hydrocarbons was used in this work.

In preliminary experiments at 6–14°C. [42·8–57·2°F.], desinsectalin was tested against *Ctenocephalides* (*Ctenocephalus*) *canis*, Curt., *Haematopinus suis*, L., a Trichodectid from horses, and *Psoroptes equi*, Hering. Contact action was tested by mixing batches of examples with the powder in petri dishes (closed in the case of the fleas) and fumigant effect by placing them on watch glasses in closed dishes containing it, or, in the case of *Haematopinus*, in test-tubes covered with muslin and placed in further tubes containing the powder. As a result, the fleas died in 8–10 minutes and the Trichodectid in 15 minutes. *Haematopinus* showed great activity in the tubes for 10–15 minutes but died in 40–50 minutes. When the mange mites were subjected to contact with the powder for up to 10 minutes they retained their ability to move three days later, but when the temperature was raised by standing the powder and the watch-glass containing the mites on a tumbler of hot water for 5–30 minutes, after which the mites were transferred to clean tubes, they all became motionless within a day.

Dogs and cats were freed from fleas and Trichodectids by rubbing the powder into the skin by hand and repeating the treatment a few days later. Brushing horses with the powder, applying it to cows by means of a dusting machine and rubbing it on the skin of pigs by hand destroyed Trichodectids on the horses, Trichodectids and Anoplura on the cows and *H. suis* on the pigs; it freed the pigs from the lice within 30 minutes. Horses were cured of mange caused by *P. equi* after three applications at intervals with a brush, and all but one of 34 sheep infested in varying degrees with *P. ovis*, Hering, by two or three very thorough applications of the dust.

[Potemkina (V. A.).] **Потемкина (В. А.). On the Control of Monieziasis of Calves.** [*In Russian.*]—*Veterinariya* **23** no. 4 pp. 6–7. Moscow, 1946.

Investigations in 1940 and 1941 showed that the intermediate hosts in the Soviet Union of the Cestodes, *Moniezia expansa* and *M. benedeni*, which infest sheep and calves, are the Oribatid mites, *Galumna obvius*, Berl., *Scheloribates laevigatus*, Koch, *S. latipes*, Koch, and *Adoristes ovatus*, Koch [*cf. R.A.E.*, B **33** 165]. Development to the infective cysticercoid stage in these mites was completed in 120–170 days. Calves become infested on the pastures in summer, through ingesting mites containing overwintered cysticercoids, and

again in autumn in districts in which the worms have developed in the mites in summer. The administration of copper sulphate solution, as practised in the case of sheep, proved effective for the treatment of calves.

[Lagereva (M. G.).] **Лагерева (М. Г.). Diseases of Animals caused by Parasites of the Blood.** [*In Russian.*]—*Veterinariya* **23** no. 4 pp. 9–14. Moscow, 1946.

This summary of the results obtained by veterinary workers in the Soviet Union, chiefly in the treatment of various forms of piroplasmosis in domestic animals, includes a brief account (pp. 12–13) of experiments by V. I. Kurchatov in Transcaucasia on dips for sheep simultaneously infested with the mange mite, *Psoroptes ovis*, Hering, and Ixodid ticks. Good control of the mite and of the ticks, *Hyalomma marginatum*, Koch, *Rhipicephalus bursa*, C. & F., and *R. turanicus*, Pomerantzev, was given within 24 hours by dipping the animals in a 2 per cent. emulsion of creolin with the addition of 0·10–0·11 per cent. As_2O_3 as sodium arsenite, and of the mite and the ticks, *R. bursa* and *H. anatolicum*, Koch, by dipping in a 2 per cent. suspension of pyrethrum powder (0·4 per cent. pyrethrins) with 0·09 per cent. As_2O_3.

[Baskakov (V. P.).] **Баскаков (В. П.). Something new in the Biology of the Sheep Bot-fly and Measures for its Control.** [*In Russian.*]—*Veterinariya* **23** no. 4 pp. 15–16. Moscow, 1946.

It is generally thought that *Oestrus ovis*, L., has only one generation a year in Uzbekistan, development of the larvae to the third instar requiring 9–10 months in sheep infested during the summer, after which larvae drop from the nasal cavity, pupate in the soil and give rise to adults in May and June. Although this may be true for full-grown sheep, larvae deposited in the nasal cavities of young lambs in May reached the third instar in July, and individuals that were then extracted from the frontal sinuses and placed in cages gave rise to females that produced larvae in the same autumn. Larvae were rare in young lambs dissected in August or the beginning of September. The first-instar larvae occur in the nasal passages where they are easily accessible for control, and infested animals should be treated before the larvae reach the second or third instar, when they migrate to the posterior nasal structures and the frontal sinuses.

Adults were found to be present in Uzbekistan from the beginning of May until mid-June, and again from 1st September to 1st December. They were inactive between 7 and 11 a.m. and from 4 to 7 p.m., during which periods they rested on walls, wells, tents, tall bushes and sheep. Hand collection is therefore suggested as an effective control measure [*cf. R.A.E.*, B **34** 85]. In addition, infested sheep should be treated between 15th June and 1st September, and between 1st October and 1st December, with a freshly prepared mixture of carbon bisulphide, alcohol and water. The proportions of the three ingredients and the quantity injected per nostril are 1 : 10 : 40 and 50 cc. for sheep and 1 : 20 : 80 and 25 cc. for lambs.

Hackman (R. H.). **The Preparation of some Emulsions containing DDT.**—*J. Coun. sci. industr. Res. Aust.* **19** no. 1 pp. 77–85, 2 figs., 6 refs. Melbourne, 1946.

Emulsions of the oil-in-water type containing DDT, required for the control of insects that attack animals and plants, are most easily obtained by diluting concentrates with water until the desired strength of DDT is obtained. The concentrates are either of the soluble-oil type, consisting of a solution of DDT in oil, to which an emulsifier has been added to form a homogeneous solution

readily dispersed in water, or of the mayonnaise type, which are concentrated emulsions consisting of solutions of DDT in oil dispersed in water with the aid of an emulsifying agent. The former usually contain a higher proportion of DDT, since no water is present, and are therefore cheaper to transport, and they may be diluted with either water or oils, but require more emulsifier than the mayonnaise type to obtain satisfactory emulsification. Since mechanical force is used in the preparation of mayonnaise concentrates, relatively small amounts of emulsifier are required and a wider range of materials may be used. Mayonnaise concentrates are not inflammable.

The investigations described in this paper were confined to the preparation of soluble-oil concentrates, but owing to the limited selection of solvents available in Australia, difficulty was experienced in preparing concentrates containing a high proportion of DDT and having the reasonably high flash points necessary to reduce the danger of fire. Tests were carried out with 17 solvents, including some vegetable oils, with anionic, non-ionic and cationic emulsifying agents, and with adjuvants such as glyceryl mono-oleate and aluminium naphthenate, to prevent penetration of the spray solution into leaf tissue and increase oil deposit. When the emulsifier was not miscible with the solvent, a suitable coupling agent, such as glyceryl mono-oleate, the lower alcohols, cetyl alcohol, lauryl alcohol, cresylic acid or cyclohexanol, was used to effect solution. Dibutyl and dimethyl phthalates, kerosene and the cationic agents were eliminated because they caused injury to plants, and others because they were scarce. As a general rule, 10 per cent. by weight of the emulsifier was included in the concentrate to ensure emulsification with the minimum of agitation. Satisfactory emulsions were prepared with 5 per cent. or less emulsifier, and usable emulsions have been made from concentrates containing as little as 0·3 per cent., but the amount of mechanical agitation necessary for the production of the emulsion is increased as the concentration of emulsifier is decreased. Increasing the amount of an emulsifier that is not normally miscible with the solvent to 20 per cent. or more prevented the undesirable separation of the concentrate into two layers, but generally decreased the amount of liquid retained on the sprayed surface, because of increased run-off, and was more expensive than adding a coupling agent. To obtain satisfactory soluble-oil concentrates, it was found advisable to avoid the use of emulsifiers that are preferentially water-soluble, such as the sodium alkyl sulphates and sodium alkylaryl sulphonates, unless suitable coupling agents were added. Generally, the emulsions are required to be stable for a few hours only and some agitation is permissible. The specifications of some of the solvents and emulsifying agents used are given in appendices.

One of the best emulsions was prepared from a concentrate consisting of DDT, toluene and an Australian proprietary emulsifying agent (Soaxit) (30 : 60 : 10 by weight). It was extremely stable and showed no tendency to cream, and the oil particles dispersed in the water had a diameter not exceeding 4–5μ, most of them being much smaller. Reducing the amount of emulsifier in the concentrate to 5 per cent. did not appreciably affect the stability of the resultant emulsion. Other solvents, such as xylene, Shell solvent X6, and oil of *Eucalyptus dives* (typical form) also gave extremely stable emulsions with the same emulsifier.

NORRIS (K. R.). **The Testing of the American Horn Fly Trap, and a new Type of Trap involving the Use of DDT against the Buffalo Fly,** *Siphona exigua* **(de Meijere).**—*J. Coun. sci. industr. Res. Aust.* **19** no. 1 pp. 65–76, 1 fig., 9 refs., Melbourne, 1946.

The spread of *Siphona* (*Lyperosia*) *exigua*, de Meij., to the east coast of Queensland from Daintree to Townsville in 1942–43 [*R.A.E.*, B **33** 152]

exposed considerable numbers of dairy cattle, notably on the Atherton Tableland, to attack for the first time. Research on the control of the fly, which had been abandoned owing to the apparent impracticability of taking measures on beef cattle, was therefore resumed. A trap based on one described in America [**26** 248] was tested [**33** 152], and the experiments in 1944 leading to the recommendation of this trap for general use are described. Two bulls and 58 cows passed through the experimental trap twice daily on the way to the milking yards and in the latter part of the test period on their way back from the yards also. The origin of the flies that continually reinfest herds even though the trap is used four times a day was investigated. It was found that bulls and calves that do not pass through the trap act as reservoirs and that flies move from one herd to another on adjoining property. If all the cattle on a property used a trap, the emergence of flies from dung on the property itself would probably be considerable only for about the first fortnight after the beginning of trapping, as flies bred on the property would not have time to become sexually mature before they were caught. However, some would probably develop from eggs laid by mature flies coming from another property. Apart from *S. exigua*, the only blood-sucking fly of importance to cattle owners on the Atherton Tableland is *Stomoxys calcitrans*, L. Infestations on dairy herds occasionally rise to serious proportions. The numbers of this species caught on each of seven consecutive days in April ranged from 510 to 1,132. As *Stomoxys*, unlike *Siphona*, does not remain constantly on the cattle and is less attracted to light, the trap is not so effective against it. Suggested modifications for the original trap are the addition of a roof of corrugated iron to give protection from rain and the omission of the weighted strips [**35** 73].

The simpler, more weather-resistant trap in which DDT is used [**35** 73] is also described. The glass sides are protected from the cattle by wire netting. The triangular spaces over the ends of the passageway were closed with a flexible, gauze-reinforced cellophane material and partitions of the same shape were placed under the roof over each set of curtains. The use of transparent material is probably not essential. The concentration of DDT on the glass in the test trap was about 0·14 gm. per sq. ft. Within a few days of the installation of the trap in February 1945, infestation had been reduced from 200–300 flies per cow and 5,000–10,000 on the bull [**35** 73] to about six per cow and 150 on the bull, and it was maintained at about six per cow throughout the season with generally less than 100 on the bull. Ten weeks after the glass had been sprayed, contact with it for 2–5 seconds still affected most flies in test tubes held against it. This suggested that one treatment with DDT applied in suitable concentration in some adhesive preparation, would last throughout a season.

Results obtained with the two types of trap cannot be accurately compared as the flies are not retained in the newer one, but assuming that all flies that came into contact with the treated glass were killed, the glass trap would probably be more effective than the gauze one because of the better lighting. The light values in various parts of the two traps as measured on 27th July 1945 are compared in a table.

Belschner (H. G.). **The Buffalo Fly** (*Lyperosia exigua*). **A Survey of the Position and a Discussion of Control Measures.**—*Agric. Gaz. N.S.W.* **57** pts. 3–4 pp. 149–152, 211–214, 218, 3 figs. Sydney, 1946.

By 23rd October 1945, *Siphona* (*Lyperosia*) *exigua*, de Meij., had extended southwards in Queensland to Bororen near the coast (between Gladstone and Maryborough), Baralaba in the Dawson Valley and Springsure [*cf. R.A.E.*, B **33** 152]. It was apparently becoming active again at that time, and an early extension of the infested area was anticipated. In view of the danger of its

soon reaching the dairying districts of northern New South Wales, its appearance is described and notes are given on its bionomics, introduction into Australia and spread there, its economic importance, and its control by the use of traps for dairy herds [see preceding abstract, etc.] and spraying with DDT solutions or, preferably, emulsions of them in water [*cf.* **33** 152 ; **35** 73]. Formulae are given for three simple emulsions that have caused little irritation to the skin of the animals.

HEGH (E.). **Les tsé-tsés. Description—biologie—moyens de destruction.**— $8\frac{1}{2} \times 5\frac{1}{2}$ ins., 115 pp., 4 pls., 21 figs., refs. Brussels, Minist. Colon. Dir. gén. Agric., 1946.

The object of this booklet is to provide a summary of knowledge on tsetse flies (*Glossina*), particularly those that occur in the Belgian Congo, and to indicate the main points requiring further study. Introductory notes are given on the principal morphological and some anatomical characters of the adults, the structure of their mouth-parts and their method of biting, as well as on classification and general distribution, and keys to the groups and species and a tentative key to the pupae of certain species are included. Pairing, larviposition, pupation and adult emergence are described with reference to the literature, specific differences being discussed, and general descriptions are given of the larva and pupa, with notes on specific differences in pupae and on the duration of the pupal period and the sites in which pupation occurs. The habitat, activity and feeding habits of the adults are described, and morphological, biological and distributional notes are given on each of the 15 species and subspecies known to occur in the Belgian Congo and briefer ones on the six species not yet recorded there.

A chapter on natural enemies (parasites and predators of the immature stages and adults and the carnivora and biting flies that deprive the adults of hosts) is followed by one on control measures, including clearing, destruction of game, destruction of pupae in their natural foci or in artificial ones, protection and rearing of parasites, trapping of adult flies, protection of man and animals by the use of repellents or other means, and possibly protecting animals by the application of DDT or 666 [benzene hexachloride] to them or to their stables or sheds.

A list of publications on *Glossina* by the author is appended.

ULMANN (E.). **Die regulatorische Bedeutung der Bevölkerungsdichte für das natürliche Gleichgewicht einer Art. Experimentalversuche mit *Culex pipiens autogenicus* Roub.** [The regulatory Importance of Population Density for the natural Balance of a Species. Experiments with *C. p. autogenicus*.]— *Z. angew. Ent.* **28** pt. 1 pp. 1-61, 17 figs., 73 refs. Berlin, 1941.

A detailed account is given of laboratory experiments carried out to assess the factors that maintain the natural balance of an insect population, and in particular to determine the influence of population density on the rate of increase of *Culex pipiens* var. *autogenicus*, Roub., and the physiology of the individual . Preliminary experiments, in which larvae of *C. fatigans*, Wied., were subjected to underfeeding, overfeeding and overcrowding, showed that hunger, whether caused directly by deprivation of food or indirectly by overcrowding, and overfeeding both caused an increase in larval mortality, and that overcrowding caused a decline in oviposition in the resulting females. The ratio of males to females, which under optimum feeding conditions approached 1 : 1, was observed in these experiments to increase to almost 2 : 1.

In the main experiments, the technique of which is described in detail, a small population of *C. p. autogenicus* was allowed to breed freely in a constant environment at a temperature of about 25°C. [77°F.], with sugar and water

provided as food for the adults. It was observed that the adult population increased to a maximum within a single generation and was then maintained at that level by the mortality of young larvae that ensued when the density of the population became excessive. The feeding of large numbers of larvae on amounts of food that had been sufficient for the original population not only caused hunger, but also stimulated the larvae to increased activity so that they disturbed one another. The size and fecundity of the adults were both reduced. It is concluded that overcrowding not only reduces the likelihood of survival of the larvae, but also impairs the prospects of future increase of mosquito populations, so that destruction of breeding places as a measure of control is justified, even though not all of them are destroyed.

ROUBAUD (E.). **Le problème de l'espèce chez le moustique commun** *Culex pipiens* **L.**—*Bull. Soc. Path. exot.* **38** no. 1–2 pp. 47–60, 3 figs., 9 refs. Paris, 1945.

The author recalls that he distinguished two biotypes of *Culex pipiens*, L., on physiological grounds in 1929 [*R.A.E.*, B **17** 108] and named them *C. p. pipiens* and *C. p. autogenicus*, Roub. [**21** 267], and that Marshall & Staley raised *C. p. autogenicus* to specific rank on the basis of certain morphological differences and applied to it the name *C. molestus*, Forsk. [**25** 136; *cf.* also **33** 94]. He indicates the principal morphological characters of the two forms as recognised by Marshall & Staley [**25** 136] and states that all these characters are subject to more or less variation. Nevertheless, as many biotypes can now be recognised among both autogenous and non-autogenous forms [**24** 22; **33** 63] and must have subspecific status, he accords specific rank to the fundamental biotypes under the names of *C. autogenicus* and *C. pipiens*.

Two well defined morphological types of *C. autogenicus*, one with the ventral surface of the abdomen without spots, as described by Marshall & Staley, and one with black spots on the median lines of the ventral surface, are here designated *sternopallidus* and *sternopunctatus*, respectively. Both are stenogamic and homodynamic. The two strains of *sternopallidus* in the author's possession come from Aigues-Mortes and the Pyrenees, respectively. They differ slightly from one another morphologically and biologically and in their relative autogenous power. Of two strains of *sternopunctatus*, one from Arles shows the black spots consistently, but in the other, which is from Paris, they are variable and in about one-fifth of the examples are altogether lacking. This strain is thought to be the product of hybridisation between the two forms. Hybridisation among various forms and even the two species is believed to occur frequently in nature and greatly to complicate classification. Hybridisation experiments with *sternopunctatus* and *sternopallidus* showed that the dark markings in the crosses obey the Mendelian laws.

Biological differences also exist among the various regional populations of the non-autogenous forms [**33** 64], but they have not been sufficiently studied for their true significance to be assessed. Two biotypes are at present recognisable, the rural *C. pipiens pipiens*, which is eurygamic, heterodynamic and ornithophilous, and *C. p. berbericus*, Roub., which is stenogamic, homodynamic and anthropophilous. Asthenobiosis [*cf.* **17** 108] and adipogenic autotrophy [*cf.* **21** 267], which characterise rural non-autogenous populations of hibernating *C. pipiens* in France, were not observed during studies made in December 1943 on females of various autumn and winter generations from the south. This, together with the fact that females take blood-meals in autumn in the south, shows that hibernation in this mosquito is conditional and thus different from that of *C. pipiens* from colder parts. Strains of *C. p. berbericus* from Algeria that sometimes showed autogenesis [**27** 213] were probably hybrids.

It is concluded that non-autogenous, stenogamic, anthropophilous and homodynamic populations corresponding to *C. p. berbericus*, pure or hybridised with autogenous forms, probably exist in North Africa, the south of France and other Mediterranean regions [*cf.* **33** 63]. The females lay elongated egg rafts. The non-autogenous form from Richelieu [**33** 63, 64] is provisionally considered a hybrid between the non-autogenous rural *pipiens* and a stenogamic type. Some of the larvae died before hatching as is common after cross matings [*cf* **30** 50]. Crossing males of *C. a. sternopallidus* with females of *C. a. sternopunctatus* always resulted in complete sterility of the eggs. It is concluded that *C. pipiens* and *C. autogenicus* are species in the process of evolution, well characterised physiologically but not morphologically.

CARPENTER (S. J.), MIDDLEKAUFF (W. W.) & CHAMBERLAIN (R. W.). **The Mosquitoes of the southern United States east of Oklahoma and Texas.**—*Monogr. Amer. Midl. Nat.* no. 3, 9¼×6 ins. [7+] 292 pp., frontis., 155 figs., 188 refs. Notre Dame, Ind., Univ. Notre Dame, 1946.

This monograph is concerned with the CULICINAE of Missouri, Kentucky and Virginia and the States to the south of these and contains descriptions of the adults of both sexes and larvae of the genera and species, with notes on the distribution and bionomics of each species and its medical importance, if any. There are also keys to the genera and species, including adults of both sexes and larvae in most cases, as well as to the adults, pupae and larvae of the subfamilies of CULICIDAE and tribes of CULICINAE and descriptions of the characters used for identification in all stages. Notes are included on the general bionomics and medical importance of mosquitos, and the technique of collecting eggs, larvae and adults, rearing larvae, mounting and storing larvae and adults, transporting adults, preparing male terminalia and cibarial (pharyngeal) armatures for study, dissecting for malaria parasites and identifying mosquitos.

HEILESÉN (B.). **Studies on *Acarus scabiei* and Scabies.**—*Acta derm. venereol.* **26** Suppl. 14, 370 pp., 14 pls., 39 figs., 13 pp. refs. Copenhagen, Rosenkilde & Bagger, 1946.

This work is divided into two parts. The first consists of a survey of the development of knowledge on the morphology, internal anatomy, bionomics and pathogenic significance of *Sarcoptes* (*Acarus*) *scabiei*, Deg., the histology and transmission of scabies, sensitisation, and the effect of remedial measures on the mite and its eggs, and the second comprises an account of the author's own observations on the subject. In studying ways in which scabies can be acquired [*cf. R.A.E.*, B **32** 233, etc.], he found that the ovigerous female mite may survive for 2–3 days away from the host at ordinary room temperature and atmospheric humidity and still be capable of infecting a person. An enquiry as to the circumstances under which 274 scabies patients became infested, the results of which are given in some detail, showed that 231 had slept with an infested person, 29 had had other contact with an infested person, eight had used a patient's clothing, five had lain in a bed that had been occupied by a scabies patient less than 24 hours previously, and one had made a patient's bed. For the treatment of persons infested with 10 ovigerous female mites or less, it is considered sufficient to make one application of 5 per cent. tetraethylthiuram monosulphide (thiosan), dixanthogen (10 per cent. in vaseline) or benzyl benzoate lotion (equal parts of benzyl benzoate, isopropyl alcohol and soft soap), but this does not kill all the eggs. For patients with larger mite populations, two applications at intervals of 4–5 days are suggested.

ROTH (L. M.). **Aberrations and Variations in Anopheline Larvae of the south-eastern United States (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **47** no. 9 pp. 257–278, 66 figs., 7 refs. Washington, D. C., 1945.

Various types of aberrations and the number of specimens of each found in larvae of *Anopheles quadrimaculatus*, Say, *A. punctipennis*, Say, *A. crucians*, Wied., and *A. c. bradleyi*, King, in the south-eastern United States, principally between June and August 1944, are tabulated, and these and a few variations in larvae of *A. atropos*, D. & K., are discussed. In general, the different anomalies are common to the several species. Their cause is not known. It is probable that the more unusual are not genetically transmitted.

CERQUEIRA (N. L.) & LANE (J.). **Note on *Haemagogus capricornii* Lutz, 1904 (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **47** no. 9 pp. 279–288, 10 figs., 6 refs. Washington, D.C., 1945.

Descriptions are given of the larvae, pupae and adults of both sexes of mosquitos considered to be *Haemagogus capricorni*, Lutz, bred from females taken in Brazil in the type area of this species near the city of São Paulo in April 1944. Lutz described *H. capricorni* from females only, briefly in 1904 and more fully in 1905. His second description is quoted. The characters of the females agree with those described by Lutz and with those from Bolivia described by the senior author [see next abstract], and the characters of the males with those from Brazil described by the latter [*loc. cit.*]. These males belonged to the material from the females of which the yellow fever virus was isolated by Shannon, Whitman & Franca [*R.A.E.*, B **27** 121]. On the other hand, the only species so far found in the Ilhéus yellow-fever endemic area in southern Bahia is *H. spegazzinii*, Brèthes, and this is probably the mosquito used by Antunes & Whitman in their transmission experiments [**26** 65].

CERQUEIRA (N. L.). **Algumas espécies novas da Bolívia, e referência a três espécies de *Haemagogus* (Diptera, Culicidae).** [On some new Bolivian Species, and three Species of *Haemagogus*.]—*Mem. Inst. Osw. Cruz* **39** fasc. 1 pp. 1–14, 4 pls., 9 refs. Rio de Janeiro, 1943. (With a Summary in English.) **Lista dos mosquitos da Bolívia (Diptera, Culicidae).** [A List of the Mosquitos of Bolivia.]—*T.c.* pp. 15–36, 2 figs., 9 refs. (With a Summary in English.) **Um novo meio para montagem de pequenos insetos em lâminas.** [A new Medium for mounting small Insects on Slides.]—*T.c.* pp. 37–41. (With a Summary in English.)

In the first of these papers, three new species of *Psorophora*, one of *Culiseta* (*Taeniorhynchus*) and one of *Aëdes*, taken between 1933 and 1942 in Bolivia by the Bolivian Yellow Fever Service, are described, with notes on their local distribution. The mosquitos taken also included females of *Haemagogus capricorni*, Lutz, and adults of both sexes of *H. uriartei*, Shannon & Del Ponte, and *H. spegazzinii*, Brèthes. Descriptions are given of the females, males and male genitalia of all three species, based on the Bolivian material and on males of *H. capricorni* from Brazil [*cf.* preceding abstract]. The author has examined a microphotograph of the male genitalia of *H. janthinomys*, Dyar, from Trinidad, and considers this species to be identical with *H. spegazzinii* [*cf. R.A.E.*, B **27** 121].

The second paper contains a list of all the mosquitos collected during the survey that could be identified. They were taken in districts in which yellow fever has been found and comprise 126 species in 15 genera. Notes are given on their distribution and in a few cases the morphology of hitherto undescribed stages.

In the third paper, directions are given for preparing a new medium for mounting stages or parts of mosquitos or other small insects on slides, having

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as base colophony and gum copal dissolved in a mixture of alcohol, camphor, turpentine and eucalyptol. A modification of this solvent by the addition of glacial acetic acid for purposes of preliminary fixation is also described.

NEIVA (A.) & LENT (H.) **Triatomídeos do Chile.** [Triatomines of Chile.]—*Mem. Inst. Osw. Cruz* **39** fasc. 1 pp. 43–75, 4 col. pls., 6 figs., many refs. Rio de Janeiro, 1943.

The Triatomine Reduviids known to occur in Chile comprise *Triatoma infestans*, Klug, *T.* (*Eutriatoma*) *rubrovaria*, Blanch., *T.* (*E.*) *sordida*, Stål, and the species for which the authors consider the correct names to be *T. spinolai*, Porter, and *Triatomaptera porteri*, Neiva & Lent [*cf. R.A.E.*, B **34** 21, etc.]. The original descriptions of all five are reproduced, the first four are redescribed in detail, and notes are given on the habits and distribution of the first three. The only one definitely stated to have been found infected with *Trypanosoma* (*Schizotrypanum*) *cruzi* in Chile is *T. infestans* [but *cf.* **31** 180].

DE SOUZA-ARAUJO (H. C.). **Verificação, em condições naturais, da infecção de mais três hematófagos (Anophelineos, Flebótomos e Simulídeos) em leprosos.** [Confirmation under natural Conditions of the Infection of three more Blood-sucking Organisms by Lepers.]—*Mem. Inst. Osw. Cruz* **39** fasc. 2 pp. 167–176, 14 figs. Rio de Janeiro, 1943. (With a Summary in English.)

DE SOUZA-ARAUJO (H. C.). **Culturas de bacilos ácido-álcool resistentes isolados de hematófagos infectados em leprosos. Evidências de se tratar do bacilo de Hansen.** [Cultures of Acid- and Alcohol-fast Bacilli isolated from Blood-sucking Organisms infected by Lepers. Proofs that Hansen's Bacillus is involved.]—*Op. cit.* **40** fasc. 1 pp. 9–31, 1 col. pl., 40 figs. 1944. (With a Summary in English.)

DE SOUZA-ARAUJO (H. C.). **Verificação da infecção de moscas da familia Tachinidae pela *Empusa* Cohn 1855. Essas moscas, sugando ulceras lepróticas, se infestaram com o bacilo de Hansen.** [The Finding of Infection of Tachinid Flies by *Empusa*. These Flies, sucking leprous Lesions, become infected with Hansen's Bacillus.]—*Op. cit.* **41** fasc. 1 pp. 201–203, 2 figs. (With a Summary in English.)

DE SOUZA-ARAUJO (H. C.), MARIANO (J.) & DE OLIVEIRA CASTRO (G. M.). **Tentativas de transmissão da lepra ao homem, por meio de Triatomídeos infectados em doentes lepromatosos. (Nota prévia.)** [Attempts to transmit Leprosy to Man by Means of Triatomines infected by Leprosy Patients. (Preliminary Note.)]—*T.c.* fasc. 3 pp. 495–505, 4 figs. 1945. (With a Summary in English.)

DE OLIVEIRA CASTRO (G. M.) & MARIANO (J.). **Transporte e inoculação de bacilos da lepra pelos mosquitos.** [Carriage and Inoculation of Leprosy Bacilli by Mosquitos.]—*T.c.* pp. 511–524, 2 col. pls., 3 figs.

In the first of these further accounts of investigations carried out in Brazil on the relation between Arthropods and leprosy [*cf. R.A.E.*, B **35** 81–82], it is recorded that leprosy bacilli were found in adults of two species of *Anopheles* (*Nyssorhynchus*), and in those of *Phlebotomus* (*Flebotomus*) *intermedius*, Lutz & Neiva, and *Simulium* sp., probably *S. pertinax*, Kollar, taken while feeding on lepers in Minas Gerais. Bacilli were observed in the proboscis and stomach of *P. intermedius*. Further naturally infected examples of *Phthirus pubis*, L., and *Amblyomma cayennense*, F., were taken on patients in a leper colony.

The second paper contains information on various cultures of acid- and alcohol-fast bacilli, including some that were obtained in previous work from examples of *A. cayennense* and *Boophilus annulatus microplus*, Can., that fed on lepers in experiments and from *Triatoma infestans*, Klug, found in huts

inhabited by lepers. They did not differ materially from cultures of Hansen's bacillus.

It is stated in the third that flies taken outdoors while feeding at an ulcer on a leper in Minas Gerais in 1944 proved to be Tachinids, though the species was not determined. All were dead on the following morning, and examination of their stomach contents showed the presence of an unidentified fungus of the genus *Empusa* (not *E. muscae*) and acid- and alcohol-fast bacilli. Further flies taken in similar circumstances proved to be *Cochliomyia macellaria*, F., but attempts to isolate bacilli from them were inconclusive. The stomach contents of house-flies [*Musca domestica*, L.] taken feeding at ulcerated lesions on a leprosy patient in hospital showed abundant acid- and alcohol-fast bacilli.

The fourth paper contains an account of experiments in 1944 in which an attempt was made to transmit leprosy to man by the bites of *Triatoma infestans* and *Panstrongylus megistus*, Burm. The bugs (mostly nymphs) were allowed to bite active lepers repeatedly and were then transferred singly or in small batches and after varying intervals of time to selected sites on four burned-out lepers, who were bitten in all 11–36 times each. Three of these volunteers showed moderate local reactions 1–4 days after the first bites. Smears taken some five months later from the region of the bites showed the presence of a few acid- and alcohol-fast bacilli in all three. Observations on these volunteers were to be continued, but estimation of the results was complicated by the fact that it is still uncertain whether or not re-infection of burned-out lepers is possible.

In the last paper, an account is given of experiments in 1943–44 to ascertain whether leprosy can be transmitted by the bites of mosquitos [*cf.* **12** 54]. In addition to unidentified examples, the mosquitos used were *Anopheles* (*Nyssorhynchus*) *albitarsis*, Arrib., *A.* (*N.*) *strodei*, Root, and *Psorophora ciliata*, F. When mosquitos taken in the open after biting active lepers were allowed to bite the forearms of four abacilliferous (burned-out) volunteers during the succeeding night, abnormal lesions were still visible on two of the latter four days later, and acid and alcohol-fast bacilli were found in lymph taken from the lesions, though not in that from the surrounding skin. Positive results were also obtained 14–31 days after the mosquitos fed in three of five similar tests, and histological examination of the injured skin from one volunteer showed that the bacilli were present in the interspaces in the connective tissue, but not in the cytoplasm of the cells, where they usually occur in leprosy lesions. These results might have been due to the presence all the time of a few bacilli in the apparently abacilliferous volunteers and their possible subsequent multiplication at the site of the bite, but in tests to ascertain whether this was so, bacilli were found in lymph from the bites of infected mosquitos on three of six volunteers and not in that from bites of uninfected mosquitos of the same species on any of them. Further tests showed that the prolonged reaction to the infecting bites was not due to the carriage on the mouth-parts of the mosquito of albumins of human origin derived from the individual on whom they had previously fed and that the reactions of active lepers to the bites of infected mosquitos were in no way abnormal.

Dias (E.) & Torrealba (J. F.). **Verificação de flagelados semelhantes ao *Trypanosoma rangeli* Tejera, em *Rhodnius prolixus* alimentados em caso de doença de Chagas na Venezuela. Considerações sôbre a natureza dêste protozoário.** [The Discovery of Flagellates resembling *Trypanosoma rangeli* in *Rhodnius prolixus* fed on a Case of Chagas' Disease in Venezuela. Considerations on the Nature of this Protozoon.]—*Mem. Inst. Osw. Cruz* **39** fasc. 3 pp. 265–278, 2 pls., 12 refs. Rio de Janeiro, 1944. (With a Summary in English.)

The following is based on the authors' summary and conclusions. When blood from an acute case of Chagas' disease in Venezuela was inoculated into

a guineapig in November 1940, a trypanosome was isolated that was morphologically distinct from the ordinary human strains of *Trypanosoma* (*Schizotrypanum*) *cruzi*. In June 1941, xenodiagnosis was performed on the same case, using examples of *Rhodnius prolixus*, Stål, reared in the laboratory. These were sent to Rio de Janeiro, where examination 65 days after the infecting feed showed the presence in the faeces of large crithidias resembling those of *T. rangeli* [*cf. R.A.E.*, B **8** 183], as well as metacyclic forms similar to those of *T. cruzi*. The intestinal contents of these bugs were inoculated into rhesus monkeys [*Macaca mulatta*], and a strain was isolated, identical with that observed in the blood of the guineapig. Characteristic forms of *T. rangeli* were not observed in the gut of *R. prolixus* and other laboratory-reared Triatomines that fed on animals infected with this strain, but only crithidias and metacyclic trypanosomes similar to those of *T. cruzi*. In view of these findings, it is suggested that *T. rangeli* is pathogenic to man and that certain of its forms in the insect vector are inconstant, the conditions that determine their appearance being unknown.

Pinho Simões (A. J.). **Doença de Chagas no Estado do Paraná, Brasil. Esboço epidemiológico.** [Chagas' Disease in the State of Paraná, Brazil. Epidemiological Sketch.]—*Mem. Inst. Osw. Cruz* **39** fasc. 3 pp. 279–290, 1 pl., 9 refs. Rio de Janeiro, 1944. (With a Summary in English.)

The author reviews the literature on the occurrence of Triatomines and Chagas' disease, caused by *Trypanosoma* (*Schizotrypanum*) *cruzi*, in Paraná, Brazil, and states that Triatomines taken in 1942–43 in dwellings in seven localities not hitherto known to be infested in the interior of the State all proved to be *Triatoma infestans*, Klug, the predominant domestic species in southern Brazil. Natural infection with the trypanosome was found in the bugs from two localities. The other Triatomines recorded from the State are *Panstrongylus megistus*, Burm., and *T. sordida*, Stål.

Miranda (C.). **Nota sôbre os transmissores da moléstia de Chagas ocorrentes no Estado do Maranhão, Brasil.** [A Note on the Vectors of Chagas' Disease in the State of Maranhão, Brazil.]—*Mem. Inst. Osw. Cruz* **39** fasc. 3 pp. 297–300, 9 refs. Rio de Janeiro, 1944. (With a Summary in English.)

In view of the interest in the distribution of Triatomine Reduviids in Brazil, the author states that he took examples of *Panstrongylus megistus*, Burm., in 1925 in the district of Mirador and of *Triatoma rubrofasciata*, Deg., in 1923 in that of Caxias, both in the State of Maranhão, from which only *P. geniculatus*, Latr., had previously been recorded.

Dias (E.) & Campos Seabra (C. A.). **Sôbre o *Trypanosoma conorrhini*, hemoparasito do rato transmitido pelo *Triatoma rubrofasciata*. Presença do vector infectado na cidade do Rio de Janeiro.** [On *Trypanosoma conorhini*, a Haemoparasite of Rats, transmitted by *Triatoma rubrofasciata*. The Presence of infected Vectors in the City of Rio de Janeiro.]—*Mem. Inst. Osw. Cruz* **39** fasc. 3 pp. 301–329, 2 pls., 4 figs., 41 refs. Rio de Janeiro, 1944. (With a Summary in English.)

The authors review records of the occurrence of *Trypanosoma conorhini* in *Triatoma rubrofasciata*, Deg., in various Asiatic countries and the work that led to the discovery of the rat as its vertebrate host [*cf. R.A.E.*, B **24** 66; **25** 164]. They then summarise the world distribution of *T. rubrofasciata* and state that an adult of this species taken on a guest in a restaurant in Rio de Janeiro in June 1943, into which it had probably been attracted by light, was

found to contain crithidias and metacyclic trypanosomes in its rectal contents. The metacyclic forms were smaller than those of *Trypanosoma* (*Schizotrypanum*) *cruzi* and also differed from them in other respects, and they were identified as *T. conorhini*, which had not previously been known from any American country. The crithidias were indistinguishable from those of *T. cruzi*. The parasite was transmitted to a white mouse by inoculation of excreta of the bug and transmitted to further mice, a rat and a rhesus monkey [*Macaca mulatta*] by those of *Triatoma infestans*, Klug, that fed on the infected animal. It usually caused an inapparent infection, and there was no evidence of multiplication in the blood of the vertebrate host. Its presence was demonstrated by xenodiagnosis, for which purpose *T. vitticeps*, Stål, *Rhodnius prolixus*, Stål [*cf.* **26** 156] and *Panstrongylus megistus*, Burm., proved satisfactory, as well as *T. infestans*. The morphology of the trypanosome in the blood of the vertebrate host is discussed. The examination by xenodiagnosis of five rats caught in a quarter of the city in which examples of *T. rubrofasciata* have been taken gave negative results.

Dias (E.) & Neves (O.). **Determinação da infecção natural por** *Schizotrypanum* **em** *Triatoma rubrofasciata* **no Estado de Pernambuco.** [Determination of natural Infection of *T. rubrofasciata* by *Trypanosoma* in the State of Pernambuco.]—*Mem. Inst. Osw. Cruz* **39** fasc. 3 pp. 331–334, 1 pl., 1 fig., 5 refs. Rio de Janeiro, 1944. (With a Summary in English.)

Examination of one example of *Triatoma rubrofasciata*, Deg., and 13 of *Panstrongylus megistus*, Burm., received from the district of Nazaré, in the State of Pernambuco, in August 1943, showed the presence of metacyclic forms of *Trypanosoma* (*Schizotrypanum*) sp., in the dejecta of both species.

The intestinal contents of the example of *Triatoma rubrofasciata* were inoculated into a mouse, and the forms subsequently observed in its blood were totally unlike those of *Trypanosoma conorhini* [*cf.* preceding abstract]. The infection was weak, and inoculation of the dejecta of some of the examples of *P. megistus* also produced a weak infection in a mouse. Four of 20 examples of *P. megistus* from another part of the same district were found to be infected with *Trypanosoma* (*Schizotrypanum*) sp.

Nery Guimarães (F.) & Jansen (G.). **Um foco potencial de tripanosomíase americana na Cidade do Rio de Janeiro (Distrito Federal).** [A potential Focus of American Trypanosomiasis in the City of Rio de Janeiro.]—*Mem. Inst. Osw. Cruz* **39** fasc. 3 pp. 405–417, 3 pls. (1 fldg.), 9 figs., 1 fldg. table. Rio de Janeiro, 1944. (With a Summary in English.)

The authors describe investigations undertaken in 1942 in Santa Teresa, a wooded suburb of Rio de Janeiro, to discover whether Triatomine bugs capable of carrying Chagas' disease were present. Houses were searched, particularly those constructed of clay, but no trace of Triatomines was found except in a large modern building, where eleven adults of *Panstrongylus megistus*, Burm., were taken, of which nine were found to be infected with *Trypanosoma cruzi*. They had presumably flown into the brightly lit building from the surrounding forest, as there was no evidence of their breeding in the structure, and a search was carried out in the neighbourhood to discover their breeding places. Nests of birds, bats and small forest mammals were investigated, and one egg-shell, apparently of *P. megistus*, was found in the nest of an opossum (*Didelphis marsupialis*). Examples of *Parabelminus carioca*, Lent, were found in the nests of *Didelphis* and wild rats in palm trees [*cf. R.A.E.*, B **35** 86].

Of 42 examples of *D. marsupialis* examined, 15 were found to be naturally infected with *T. cruzi*. One example of another opossum, *Metachirus*

nudicaudatus, was also caught and was shown by xenodiagnosis to be infected. No infection was found in bats (*Artibeus jamaicensis lituratus*), dogs or cats or in 58 of the local inhabitants.

From five of the nine naturally infected examples of *P. megistus*, inoculations were made into animals, and dogs and guineapigs became infected. A strain of *Trypanosoma cruzi* isolated from naturally infected *Didelphis* was pathogenic to rhesus monkey [*Macaca mulatta*], dog, cat and guineapig, and that from *Metachirus* to dog and guineapig ; mice inoculated with any of these strains showed peritoneal infection but no parasites in the peripheral blood.

COUTINHO (J. O.). *Anopheles* (*Shannoniezia*) *costalimai* **Fonseca e Ramos, 1940, novo nome e a redescrição da espécie (Diptera-Culicidae).** [*A.* (*Shannonesia*) *costalimai*, new Name and Redescription of the Species.]—*Mem. Inst. Osw. Cruz* **39** fasc. 3 pp. 425–434, 8 figs., 5 refs. Rio de Janeiro, 1944. (With a Summary in English.)

The author states that at his request Fonseca and Ramos propose the new name *costalimai* for *Anopheles* (*Shannonesia*) *limai*, Fonseca & Ramos [*cf. R.A.E.*, B **28** 220], which is preoccupied by *A. albitarsis*, Arrib., var. *limai*, Galvão & Lane [**26** 184]. He redescribes the male terminalia and gives descriptions of the larva, pupa and adults of both sexes from material collected in the State of Paraná, Brazil, together with characters distinguishing *A. costalimai* and *A. mediopunctatus*, Theo., from each other.

PINTO (C.). **Um ano de combate às doenças parasitárias que atacam os rodoviários da estrada Rio-Bahia, 1942 a 1943.** [A Year combatting the Diseases due to Parasites that attack Workmen on the Rio-Bahia Highway, 1942–43.]—*Mem. Inst. Osw. Cruz* **40** fasc. 3 pp. 209–340, 6 fldg. maps (4 col.), 6 graphs (4 fldg., 3 col.), 39 figs., 9 refs. Rio de Janeiro, 1944. (With a Summary in English.)

A medical service was established in July 1942, with headquarters in a township in the valley of the Rio Doce, Minas Gerais, for the protection from parasitic diseases of workmen engaged in building a new highroad from Rio de Janeiro to Bahia, and a detailed account is here given of the work accomplished during its first year of operation. One of the diseases encountered was malaria, and all the workmen, many of whom came from other parts of Brazil, and some of the local inhabitants were subjected to blood tests for it. The maximum percentage of positive blood smears (16·2) was registered in December 1942 ; *Plasmodium vivax* occurred in 61·3 per cent., *P. falciparum* in 35·9 per cent., and *P. malariae* in 2·7 per cent. of the 370 positive cases observed in the district.

Malaria was endemic in the valley, which is subject to extensive floods during the summer rainy season (December–March). The town had as yet no drainage, and large pools of stagnant water collected in the streets, forming favourable breeding places for Anophelines, which also bred in ditches, wells and marshes, and at the edge of the river. Of the species taken in houses, by far the most numerous was *Anopheles darlingi*, Root, which is the chief vector of malaria in the region. The control measures employed were the administration of drugs and weekly spraying in houses, etc., with a fly-spray against Anophelines.

COUTINHO (J. O.), RACHOU (R.) & FERREIRA (M.). **Considerações em tôrno de uma inspecção preliminar de malária em zona de alta endemicidade no Estado de Santa Catarina.** [Preliminary Investigations on Malaria in a Zone of high Endemicity in the State of Santa Catarina.]—*Mem. Inst. Osw. Cruz* **41** fasc. 1 pp. 1–19, 1 fig. Rio de Janeiro, 1944.

A malaria survey was carried out in October 1943 at Caldas da Imperatriz, a mineral spring resort at the head of a valley in the district of Palhoça, State

of Santa Catarina, Brazil. Of the fixed population of 256 persons, 98·4 per cent. claimed to have had malaria ; all were subjected to blood tests, and 13·3 per cent. gave positive results, 73·6 per cent. of these harbouring gametocytes. *Plasmodium malariae* was involved in nearly half the cases. Children were the most frequently infected, and it was concluded that malaria is endemic in the valley.

Pools and water courses up to a distance of 3,300 yards from the spa were examined for Anopheline larvae. The overflow from the springs, the temperature of which is 40°C. [104°F.], runs into a stream that flows in a series of pools and cascades. Larvae were found in various parts of this stream, in water at temperatures of 16–24°C. [60·8–75·2°F.]. The species, in order of abundance, were *Anopheles strodei*, Root, *A. antunesi*, Galvão & Amaral, *A.* (*Arribalzagia*) sp., *A. lutzi*, Cruz, *Chagasia fajardoi*, Lutz, *A. argyritarsis*, R.-D., and *A.* (*Nyssorhynchus*) sp. Searches were also carried out among Bromeliads growing on trees or stones, and 299 Anopheline larvae of the subgenus *Kerteszia*, of which 290 were *A. cruzi*, D. & K., were taken in 2,880 plants, mostly those growing at heights of about 6–16 feet.

Catches of adult mosquitos were made in the spa hotel and in various inhabited houses in the valley. In all, 938 Anophelines were taken, nearly all of them being *A. cruzi*. A very few of these were from unoccupied rooms in the hotel. Anophelines were also taken at nightfall attacking horses. Over 94 per cent. of these were *A. cruzi*, the others being *A. antunesi*, *A. strodei*, *A. lutzi* and four unidentified species. Examples of *A. cruzi* were also taken in a stable, a sheepfold and a fowl-house. Of the females of *A. cruzi* taken in dwellings, four of 292 contained oöcysts, but none of 132 (including these four) showed sporozoites in the salivary glands. It is concluded that *A. cruzi* is the vector of malaria in the valley, and that the principal control measure should be the destruction of Bromeliads, which provide breeding places for it.

McGovran (E. R.), Fales (J. H.) & Goodhue (L. D.). **New Formulations of Aerosols dispersed by liquefied Gases.**—*J. econ. Ent.* **39** no. 2 pp. 216–219, 1 fig., 5 refs. Menasha, Wis., 1946.

As the supply of pyrethrum was insufficient for the continued production of solutions for aerosols with the high concentration of pyrethrins (1 per cent.) first recommended [*R.A.E.*, B **31** 167], a formula containing 0·4 per cent. pyrethrins was adopted for use against mosquitos but was too weak to control other insects. Tests were therefore carried out on *Musca domestica*, L., and two species of mosquitos to devise a pyrethrum aerosol improved by the addition of other ingredients. They resulted in the development of formulae for practical and effective rather than perfected aerosols.

The following is based on the authors' summary of the results which are given in detail in tables. Formulae much more toxic than the original one were developed by increasing the non-volatile content, by increasing the proportion of sesame oil or substituting piperonyl cyclohexanone as a synergist, and by adding DDT or benzene hexachloride and suitable solvents. Freon 12 (dichlordifluoromethane) was the propellent used in most of the tests, but carbon dioxide was satisfactory in small containers of the type of soda siphon cartridges.

Goodhue (L. D.) & Riley (R. L.). **Particle-size Distribution in liquefied-gas Aerosols.**—*J. econ. Ent.* **39** no. 2 pp. 223–226, 6 figs., 4 refs. Menasha, Wis., 1946.

A detailed description is given of a method of measuring the particle size of aerosols propelled with liquefied gas by collecting the particles on oleophobic slides and projecting their image on a calibrated cross-hatched screen. The

particle size of an aerosol was found to increase as the concentration of non-volatile material in the liquefied gas increased. Studies with four types of nozzle showed that the type affects the particle size, nozzles allowing some drop in pressure and partial ebullition before the liquid is expelled being the most efficient. The particle-size distribution curves for some aerosols of different composition are given.

GLASGOW (R. D.) & COLLINS (D. L.). **The thermal Aerosol Fog Generator for large scale Application of DDT and other Insecticides.**—*J. econ. Ent.* **39** no. 2 pp. 227–235, 24 figs., 3 refs. Menasha, Wis., 1946.

Thermal aerosol fog generators show great promise for the application of insecticides on a scale hitherto often impracticable. The principle of dispersing heated oil in air as microscopic droplets to form a fog screen was found to have two drawbacks when considered as a means of dispersing DDT and other oil-soluble insecticides. Particles of the best size for screening are not suitable for applying insecticides because they rise too high, drift far and settle slowly, and the high temperature used to produce the fog would decompose substantial proportions of the dissolved insecticides. Several modifications were therefore necessary. During 1945, comprehensive tests were made in New York of two of the leading mechanisms, the Hochberg-LaMer thermal aerosol insecticide fog generator and the Todd thermal aerosol insecticide fog generator, also known as the TIFA (Todd Insecticide Fog Applicator). The former, a " wet " type generator, which was used with water and an oil solution of DDT, depended on superheated steam under controlled temperature and pressure to break up the oil solution into droplets of the desired size. The latter, as used in these field experiments, was of the " dry " type and used no water, as it was designed to produce the fog by spraying an oil solution of the insecticide into a mixing chamber where the droplets are picked up by, and heated to the desired degree in, a blast of hot air maintained at a controllable temperature and pressure, and thus dispersed into smaller droplets when discharged at atmospheric pressure. Both generators can also disperse emulsions [*cf. R.A.E.*, B **35** 69] and suspensions, and both have been adapted for operation from the air.

The Hochberg-LaMer generator was used experimentally with good results against canker-worms and to suppress blackflies [Simuliids] around a club. The Todd generator was used in all the other tests dealt with in this paper. To control Simuliids on a golf course extending over more than 60 acres, it was mounted on a truck to dispense a 5 per cent. solution of DDT in fuel oil. About 0·2 lb. DDT per acre was used over most of the area to effect direct kill, but about 10 acres at the most intensely infested corner were treated with 2 lb. per acre with a view to leaving a toxic residue. The results of this work are not given, but the interior of the club-house was heavily treated, and Simuliids and other Diptera were still being swept up two weeks later. To control Simuliids in a lake-shore village and hotel, a 5 per cent. solution of DDT in kerosene was used at about 0·2 lb. DDT per acre with the generator mounted on a boat. Hair from the back of a cow exposed to the fog and subsequently left on pasture through sun and rain for 13 days was then placed in a large glass tube. It killed most of the Simuliids caged with it in three hours, and all by the following morning. Leaves and bark of a tree 75 ft. from the lake shore were also lethal to all the Simuliids caged on them for a night, 13 days after treatment. A fog from a 5 per cent. solution of DDT in kerosene used at about 0·2 lb. DDT per acre about a clubhouse and cottages and a separate area of 3–4 acres surrounding another cottage caused the immediate disappearance of punkies [*Culicoides*], which had been extremely abundant and troublesome when the work started. Dead and feebly struggling ones were observed on porches and ground cloths. At the isolated cottage, which they

had formerly entered in great numbers through the screens when attracted by light, none appeared for three days after fogging. After this, they began to reappear and became gradually more numerous until they reached their original abundance in about a week. Significant portions of a ranch forming a compact, isolated community with a population of about 150 persons and 85 domestic animals in a narrow, somewhat swampy valley area about half a mile wide and two miles long between wooded ridges were fogged with 5 per cent. DDT in kerosene or fuel oil at appropriate intervals throughout the season from 9th June. Remarkably thorough practical control of the various kinds of Diptera present was achieved. To control flies at a refuse disposal landfill, the generator was mounted on a tug boat to fog the unloading area and on a truck to fog the heavily infested front of the landfill. The flies were swept upwards when enveloped by the DDT fog and then fell in swarms struggling feebly. When the DDT fog was directed into each manhole of service tunnels at a zoo until it escaped from the next uncovered manhole many yards away, it so filled the birdhouse that from one end it was not possible to see the opposite end 75 ft. away. The 150–160 birds apparently suffered no ill effects.

However applied, the effectiveness of an aerosol fog depends on particle size. The influence of particle size on dispersal by wind and on distribution of the toxic ingredient, which also affects hazard to non-injurious organisms, is discussed. It is thought that out-of-doors the best results may be expected with droplets measuring 10–50 microns in diameter. Coarse particles are needed for the control of forest and orchard pests from the air to give the droplets sufficient weight and rate of fall. Indoors, much smaller particles seem desirable.

GLASGOW (R. D.) & COLLINS (D. L.). **Control of the American Dog Tick, a Vector of Rocky Mountain spotted Fever : preliminary Tests.**—*J. econ. Ent.* **39** no. 2 pp. 235–240, 2 figs., 4 refs. Menasha, Wis., 1946.

Two cases of tick-borne spotted fever were reported in New York State in 1912, one in 1913, and no others until 1924. Since then, its incidence has increased, and by 1944 there had been 86 cases in the State and 16 deaths, with 17 cases and four deaths in that year alone. All but four of the 86 cases were reported from one county on Long Island, which lies in an important residential and recreational area and in which *Dermacentor variabilis*, Say, has long been very abundant [*cf. R.A.E.*, B **26** 249]. The tests described were carried out in 1945 and were designed to find a means of controlling the tick as rapidly as possible. A field laboratory was set up in an area where 1,500–2,000 ticks were easily collected for the experiments by walking along animal trails in the heath vegetation and stopping occasionally to pick the ticks from the clothing. Of various substances tested by dipping ticks in oil solutions of arbitrarily chosen concentrations, drying them on absorbent paper and placing them in stoppered glass tubes containing a strip of absorbent paper, DDT, benzene hexachloride (10 per cent. γ isomer), the pyrethrins, rotenone (derris extract) and nicotine appeared to be the most effective. Oil solutions were chosen as they appeared best suited for application as sprays from aeroplanes and as aerosol fogs from thermal generators operated from aircraft or from the ground.

In preliminary field tests, individual tufts of grass in a relatively barren area were stocked with 10–20 ticks each and sprayed with the solutions by means of a special atomiser operated by compressed air, and the ticks were then recovered and placed in cages for observation. Rotenone was not adequately tested, but DDT, benzene hexachloride, the pyrethrins and nicotine all appeared to show promise, and DDT and benzene hexachloride in combination with pyrethrins or nicotine were correspondingly more effective.

Final tests to find minimum effective dosages were, however, limited to DDT alone and in combination, as it was not certain that benzene hexachloride, which was at least equally effective, would be available in quantity in 1946. When sprays and aerosols are applied on a large scale, it may be important to use the smallest effective quantity to minimise harm to wild life. In a series of tests, a fuel-oil solution containing 0·25 per cent. weight in volume DDT and 0·0625 per cent. pyrethrins used at 2 U.S. quarts per acre, but diluted with additional oil for convenience in the tests so that application was made at 8 U.S. quarts per acre, killed 26 out of 27 ticks in five days. The one survivor was active. It is thought that these quantities would assure practical control. A solution containing half the quantities of active ingredients killed 26 ticks out of 30 and made two of the others feeble. It is, however, pointed out that these ticks were fully exposed. Waiting ticks are usually fully exposed, but it seems likely that any effective treatment would have to be repeated periodically during the season, as eggs and ticks attached to hosts would escape its action.

LEGG (J.). **Report of the Director of veterinary Services.**—*Rep. Dep. Agric. Qd 1943-44* pp. 18–21. Brisbane, 1944. **Report of the Division of Animal Industry.**—*Op. cit. 1944–45* pp. 17–23. 1945. **Report of the Acting Director, Division of Animal Industry.**—*Op. cit. 1945–46* pp. 31–43. 1946.

All these reports, each of which is for a period of twelve months ending on 30th June, contain an account of the southward spread of the buffalo fly [*Siphona exigua*, de Meij.] in Queensland and notes on its control [*cf. R.A.E.*, B **31** 122; **35** 116–117, etc). By June 1946, it had reached properties to the northeast of Mitchell, the Wandoan-Miles area in the Dawson Valley, the Eidsvold-Mundubbera area and a point just south of Maryborough on the coast. Outbreaks of tick fever [piroplasmosis] in cattle and the incidence of the cattle tick [*Boophilus annulatus microplus*, Can.] are also discussed in all the reports [*cf.* **31** 122]. In 1945–46, the situation with regard to the arsenic-resistant strain of the tick was still serious, and dipping throughout the year, at intervals of not less than a month during the cold weather and as little as 14 days in summer, was necessary to control it in some places. Weekly treatments were sometimes needed to eradicate infestations on animals that were to be moved. DDT in the form of a colloidal suspension in water at 0·5 per cent. [*cf.* **33** 152] made a dip that was as effective as arsenic under the best conditions. Anaplasmosis, due to *Anaplasma marginale*, which is rare in Queensland, caused deaths among cattle in the Beaudesert district in 1945–46, and two additional ticks, *Amblyomma triguttatum*, Koch, and *Rhipicephalus sanguineus*, Latr., were recorded on cattle in that year.

Blowfly activity on sheep is also noted in each report. Sheep were struck on the neck folds in June 1946, apparently as the result of constant wetting when walking through long grass. Sporadic infestations of sheep by *Linognathus pedalis*, Osb., were reported from the central and north-western districts in 1944–45 and 1945–46, and *Damalinia* (*Bovicola*) *ovis*, L., was extending its range into the Downs country in central and north-western areas in 1944–45, but there was practically no further spread in the latter year [*cf.* **30** 28] though observations were made on its occurrence in the marginal areas of the south-west. Reference is made in the second report to infestation of the legs of sheep by *Trombicula sarcina*, Womersley [**35** 71], and it is recorded that nymphs of this mite were recovered from soil experimentally infested with engorged larvae. They were seen 13–16 days after the larvae had engorged. Heavy infestations of sheep by *Melophagus ovinus*, L., in the Stanthorpe district during the latter part of 1945 are recorded in the third report, in which it is also stated that in preliminary tests DDT at 2 per

cent. in a colloidal suspension killed all lice on pigs and gave a promising period of protection from reinfestation. Mortality was caused among pigs at Mundubbera in 1944–45 by their eating larvae of the Pierid, *Anaphaeis java teutonia*, F., which feed on *Capparis*. Several cases of ear mange caused by *Psoroptes hippotis*, Raill. & Henry [*cf.* **35** 80] occurred in horses in 1945–46, and the horse bot-flies, *Gastrophilus nasalis*, L., and *G. intestinalis*, Deg., were particularly active in that year.

It is stated in the second report that *Pseudolynchia canariensis*, Macq., a Hippoboscid parasite of pigeons, has recently been found for the first time in Australia, and that mortalities among fowls associated with the ingestion of large numbers of the ant, *Monomorium rothsteini*, Forel, were recorded on two occasions [*cf.* **29** 53]. A programme of work begun in 1943 for the eradication of the stickfast flea [*Echidnophaga gallinacea*, Westw.] on fowls [*cf.* **31** 122] was continued with considerable success in the last half of 1944 and though it had to be curtailed in the next six months, control was maintained and the flea confined to the originally infested district. Many properties were apparently cleared of infestation, but it is difficult to keep them clear as dogs and cats carry the flea. A further outbreak occurred in September 1945 in another district, and work was concentrated there to prevent spread to the more thickly populated areas. Of the 46 properties in this district quarantined in June 1946, 35 were apparently clean. In experiments on the use of DDT for the control of *E. gallinacea* made in 1945–46, complete immersion in a 2 per cent. dip made from a 50 per cent. water-dispersible preparation gave protection against reinfestation for 16 weeks. Outbreaks of spirochaetosis of fowls [*Spirochaeta anserina*] transmitted by *Argas persicus*, Oken, caused heavy losses in laying hens on several farms in 1945–46. A poultry house heavily infested with *A. persicus* was completely freed of larvae for at least three months by spraying with a 2 per cent. solution of DDT in lighting kerosene. Adults and nymphs could always be found after treatment, though their numbers were considerably reduced.

GILMOUR (D.). **The Toxicity to Houseflies of Paints containing DDT.**—*J. Coun. sci. industr. Res. Aust.* **19** no. 3 pp. 225–232, 1 fig., 4 refs. Melbourne, 1946.

Results are given of a study of the toxicity to house-flies [*Musca domestica*, L.] of surfaces treated with white or cream paints of five different types, into which had been incorporated various concentrations of DDT (containing 70 per cent. p, p′ isomer unless otherwise stated) [*cf. R.A.E.*, B **33** 77, **34** 62, 126, 134]. The paints comprised water paint, emulsion-type paint (an oil-bound paint incorporating an emulsifying agent and made up with water for use), ordinary oil paint, flat oil paint (containing some clay and whiting and producing a thicker film and more mat surface than ordinary oil paint), and glossy enamel paint. The DDT was ground up with the paint during its preparation. Concentrations are expressed in terms of the weight of DDT per weight of dried film of paint. Some tests were made with individual flies confined for the period of exposure in wooden cells with sides 1 inch long and painted on the inner surface and then transferred to glass tubes for 24 hours. In another type of test, flies were exposed for 24 hours in a cage to one side of which a panel of plywood measuring 14×14 ins. and coated with the paint to be tested had been fixed. In both cases, the mortality was recorded at the end of the 24 hours.

The first series of experiments consisted of a comparison of the five types of paints, each made up with two different concentrations of DDT. The tests on individual flies indicated that 50 per cent. mortality would result from contact with 5 per cent. DDT in flat oil paint for 8 seconds and with 2 and 1 per cent. in emulsion-type paint for 35 and 60 minutes, respectively, while all other

combinations (2 per cent. in flat oil paint, 0·5 and 1 per cent. in water paint, and 2 and 5 per cent. in ordinary oil paint and in glossy enamel) failed to give 50 per cent. mortality after contact for one hour. The paints had been applied to the cells 14–40 days previously. The sexes of the flies are not distinguished in these tests. Males were found to be more susceptible than females. In cage tests with panels painted two days previously, 2 per cent. DDT in emulsion-type paint and 5 per cent. in flat oil paint gave complete mortality and 1 per cent. in emulsion-type paint gave 99 per cent. ; 1 per cent. in water paint, 5 per cent. in ordinary oil paint and 5 per cent. in glossy enamel gave only 15, 20 and 3 per cent. mortality, respectively. The first three treatments gave 100, 100 and 61 per cent. mortality, respectively, 42 days after application. Mortality among controls with panels treated with ordinary oil paint was 4 per cent.

A fuller range of concentrations of DDT in flat oil paint and higher concentrations in emulsion and enamel paints were studied in the second series. The tests on individual flies, which were made 3–37 days after application and in which females only were used, indicated that 5 per cent. DDT in emulsion-type paint, 2, 3, 4 and 5 per cent. DDT in flat oil paint and 20 per cent. DDT in glossy enamel would give 50 per cent. mortality after contact for 5 and 60–75 minutes and 12, 10, 7 and 4 seconds, respectively ; 10 per cent. DDT in glossy enamel failed to give 50 per cent. mortality in an hour. The insecticidal power of several of the paints, notably the enamel with 20 per cent. DDT and the flat oil paint with 3 per cent., increased as the film aged. The figures given represent the final constant levels. Increase in effectiveness was accompanied by an increase in the visible DDT on the surface of the paint [*cf.* **34** 122]. Even after several months, no DDT crystals were visible on the surface of the enamel paint containing 10 per cent. DDT. The CT values (product of concentration of insecticide and time of contact needed to produce 50 per cent. mortality) of flat-oil paint containing various percentages of DDT were consistent with the theory that DDT must be added to the paint in excess of the saturation level of the solvents in it in order that crystallisation may be initiated in the film. In the ordinary oil paint and the enamel, however, samples with 5 and 10 per cent. DDT, respectively, were relatively ineffective, although the solvents should have been more than saturated at these dosages. Other factors, probably the nature of the solvent in particular, must be involved in the initiation of crystallisation. There was no evidence of the presence of the supersaturated gum-like residue noticed by Parkin & Green [**34** 122]. Flat oil paints made up with 4 and 5 per cent. of the pure p, p′ isomer of DDT took slightly longer than the corresponding paints with crude DDT to give 50 per cent. mortality. Crystallisation may perhaps occur somewhat more readily with the crude grade. In the cage tests, 5 per cent. DDT in emulsion-type paint, 5, 4, 3 and 2 per cent. in flat oil paint and 10 and 20 per cent. in glossy enamel gave 36, 54, 20, 1, 1, 13 and 17 per cent. mortality, respectively, when the films were four days old, and the first four and the last gave 33, 91, 100, 4 and 36 per cent. mortality, respectively, when 13 days old. There was no mortality among controls. There were always many less flies resting on panels treated with the more insecticidal paints than on control panels. Although many flies alighted on the treated surfaces, they left again almost immediately.

KERR (R. W.). **Control of Fleas : Laboratory Experiments with DDT and certain other Insecticides.**—*J. Coun. sci. industr. Res. Aust.* **19** no. 3 pp. 233–240, 1 fig., 6 refs. Melbourne, 1946.

The suitability of DDT, Thanite (a blend of thiocyanoacetates of secondary and tertiary terpene alcohols) and Lethane 384 Standard (a 50 per cent. solution of β-butoxy-β′-thiocyanodiethyl ether in petroleum distillate) for the control of fleas was investigated in laboratory tests on *Ctenocephalides felis*,

Bch., carried out at 24°C. [75·2°F.]. A brief report of the main results has already been noticed [*R.A.E.*, B **35** 72]. Eggs of the flea were collected each morning from paper placed under a cage with wire bottom in which an infested kitten had been kept at night, and the larvae were reared in closed petri dishes containing sand, a pulverised mixture of dried egg yolk and dried ox blood, and moist filter paper. Under these conditions at 24°C., the life-cycle from oviposition to adult emergence lasted 20–24 days. Adult fleas survived at least four days if enough moisture was available.

A dust of one part DDT in 10 parts pyrophyllite (9 per cent. p,p′ isomer in the dust) at 0·5 and 0·01 per cent. DDT in the breeding medium did not prevent the development and hatching of the eggs. The higher concentration immobilised the larvae and killed them as soon as they hatched. The lower concentration killed all larvae but not before they had dispersed through the medium. The same concentrations in the medium and the lower concentration sprinkled on the top after the larvae had become established below the surface gave complete control of large larvae in 46 hours or less. Further tests with surface applications at 50 and 30 mg. DDT per sq. ft. resulted in complete mortality of large larvae within 24 hours.

A pyrophyllite dust containing 5 per cent. DDT by weight gave complete mortality in 24 hours of adult fleas exposed continuously on material to which it had been applied at 50 mg. DDT per sq. ft., and contact for one minute with a glass surface bearing a dry deposit of 50 mg. DDT per sq. ft. or with calico impregnated with 50 mg. DDT per sq. ft. from acetone solution also caused complete mortality. More than 93 per cent. of the fleas exposed for 30 minutes to filter paper and 65 per cent. of those exposed to calico impregnated with 20 mg. DDT per sq. ft. died in 24 hours. Calico impregnated with Thanite and Lethane 384 at 1 gm. per sq. ft. gave 27·5 and 14·6 per cent. mortality, respectively, in closed jars and 3 and 12·1 per cent. in aerated jars with a 30-minute exposure. Tests of the toxicity of filter paper impregnated with Thanite, Lethane 384, paradichlorbenzene and napththalene at 1 gm. per sq. ft. and DDT at 0·05 gm. and 0·02 gm. per sq. ft. at various times from 15 minutes to three days after impregnation again showed the superiority of the DDT. Lethane had the highest rate of paralysing action for several hours after impregnation, rendering all fleas incapable of walking or jumping in 15 minutes, but its effect after five hours was fatal to only a small proportion of the fleas. The lower concentration of DDT gave complete mortality after two days and 94·5 per cent. mortality after three days. Both the paralysing action and the toxicity of the other three substances were poor.

The visible effects of DDT on the larvae and adults are described. It is concluded that DDT should be more economical and efficient for treating the breeding places of fleas than kerosene emulsions or naphthalene [*cf. R.A.E.*, B **30** 193] and that 5 per cent. DDT in pyrophyllite may replace the less stable pyrethrum and rotenone preparations for the control of adult fleas on infested animals [*cf.* **32** 205]. However, it should not be used too frequently or in excessively large amounts on cats as they might ingest a toxic dose when licking their fur. Solutions are preferable to dusts for inhabited places, as the dusts cannot remain undisturbed for long. Used for this purpose, the residual-type fly-spray containing 4 per cent. DDT should leave a deposit of at least 200 mg. DDT per sq. ft. when painted on surfaces at the rate of 1 pint per 100 sq. ft., and such a deposit should be highly toxic to adult fleas making contact for a short time.

Kerr (R. W.) & Rafferty (W. J.). **A constant-pressure Air Valve for the Peet-Grady Atomizer.**—*J. Coun. sci. industr. Res. Aust.* **19** no. 3 pp. 241–244, 2 figs., 4 refs. Melbourne, 1946.

The following is the authors' summary. An attachment for the standard Peet-Grady atomiser (De Vilbiss Special No. 5004) which ensures delivery of all

the spray liquid at the specified pressure of 12·5 (±0·5) lb. per sq. in. is described. This attachment has the form of a spring-loaded transfer valve, which replaces the cut-off valve in the air line of the standard atomiser, and is operated by a trigger control. When the transfer valve is in the rest position, the compressed air, which operates the atomiser, escapes through a needle valve matched with the atomiser. Depression of the trigger diverts the air stream to the atomiser without alteration in air pressure. This device in no way affects the atomising characteristics of the atomiser.

HILL (J. L.). **Factors influencing the Distribution of Arsenic over the Fleece of Sheep after Immersion in arsenical Solutions.**—*J. Coun. sci. industr. Res. Aust.* **19** no. 3 pp. 245–250. Melbourne, 1946.

The following is the author's summary. The presence in dipping solutions of surface-active agents, such as suint or soap, did not affect the amount of arsenic retained on the fleece of Merino sheep following immersion in arsenical solutions, under normal dipping conditions. The staple length was found to influence the amount of arsenic retained, but wool density and the quantities of wax and suint on the wool did not seem to affect the amount of residual arsenic. The region along the mid-line of the back tended to retain more arsenic than the lateral and ventral regions.

HILL (J. L.). **The percutaneous Absorption of Arsenic by Sheep dipped in arsenical Solutions.**—*J. Coun. sci. industr. Res. Aust.* **19** no. 3 pp. 251–255, 9 refs. Melbourne, 1946.

Analysis of urine and faeces for adequate periods showed that six adult sheep, weighing 68–87 lb. and shorn 60–65 days previously, each absorbed 63–88 mg. arsenic (As_2O_3) after immersion for 30 seconds in a sodium-arsenite solution containing 0·2 per cent. w/v arsenic (normal dipping strength). They showed no ill-effects. Their heads were not submerged during dipping. The death of a severely wounded 12-months-old sheep, which was dipped in a 0·2 per cent. solution for one minute, could not be attributed directly to arsenical poisoning, but the inflammatory effect of arsenic upon a penetrating wound in the axilla, with consequent bacterial infection, was probably a contributory cause of death. The distribution of arsenic in the viscera and alimentary canals of four sheep 8–48 hours after they had been immersed for 30 seconds in a sodium-arsenite solution was determined by analysis ; and the results are tabulated. The sheep had shown no ill-effects from the dip. Little arsenic was recovered, except from the rumen, although appreciable quantities were excreted in the faeces and urine and found in the blood. The heads of the sheep had been kept out of contact with the dip. In a further experiment with one sheep, which was dipped in a 0·2 per cent. solution for 60 seconds, evidence was found that the arsenic in the rumen reaches it in the saliva, having been concentrated from the blood by the salivary glands. The saliva contained up to 30 times as much arsenic as the blood.

RUSSELL (P. F.), WEST (L. S.) & MANWELL (R. D.). **Practical Malariology.** —$9\frac{1}{4} \times 6$ ins., xix + 684 pp., 241 figs. (8 col.), refs. Philadelphia, Pa., & London, W. B. Saunders Co., 1946. Price 40*s*.

Though it is one of a series of military medical manuals, this monograph was completed after the end of the second world war and is written primarily from the standpoint of civilian needs. It includes an introduction dealing with the development of knowledge on malaria, its transmission and control, and an appendix consisting of keys to the females and fourth-instar larvae of the Anophelines of the various faunistic regions of the world and to the eggs of the Old World members of the *maculipennis* complex.

The remainder comprises six sections dealing, respectively, with the parasite, the mosquito, man, the community, prophylaxis and control, and therapeutic malaria. All except the last are divided into sub-sections. Those in the first section deal with the host range and life-cycle of *Plasmodium*, the taxonomy, morphology and physiology of the species that cause malaria in man (*P. vivax*, *P. falciparum*, *P. ovale* and *P. malariae*), the morphology and physiology of the species that cause malaria in other vertebrates, and technique for use in the study, preservation and cultivation of the parasites, serology and the use of laboratory animals. The section on the mosquito occupies some 150 pages. It includes accounts of the morphology and anatomy of adult mosquitos and the morphology of the immature stages (with brief notes on classification), of bionomics (with special reference to species of *Anopheles*) and of the distribution of the chief malaria vectors. Directions are given for collecting the immature stages of Anophelines, making adult surveys, assessing the effect of insecticides and preparing sketch maps, and there is also information on the care of specimens, the use of keys, the dissection of adult females, the making of precipitin tests, the handling of live mosquitos, the rearing of colonies of Anophelines and other mosquitos, the marking of mosquitos for release, and the determination of the age of captured adults.

The subjects dealt with in the sub-divisions of the section on man are the pathology, clinical aspects and treatment of malaria, immunity, latency and relapse, and blackwater fever. The epidemiology of malaria including its distribution and prevalence and the effects on it of climatological factors, seasonal, localised, regional and fulminant epidemics, the forecasting of epidemics, and the making of malaria surveys are discussed under the heading of the community. In the section on prophylaxis and control, which occupies some 170 pages, the various measures are classified, and aspects discussed include the control of the parasite by the prophylactic administration of drugs ; mosquito larvicides (oils, Paris green, DDT and others), drainage and filling, and miscellaneous anti-larval measures (naturalistic and mechanical devices and the management of water) ; measures directed against adult mosquitos (means of preventing them from attacking man, killing by sprays and mechanical means and prevention of the inadvertent transport of mosquitos in aircraft) ; problems mainly affecting man, such as man-made malaria, segregation of gametocyte carriers or of healthy persons, combating malnutrition, and education ; the legal measures, organisation and economic and social considerations involved in community control ; and malaria control under military conditions. References are given throughout the book at the end of each sub-section.

Cova-García (P.). **Notas sobre los anofelinos de Venezuela y su identificación.** —*Cuad. amarill. XII Conf. sanit. panamer.* no. 1, 208 pp., 93 pls., 3 fldg. tables, 8 pp. refs. Caracas, 1946.

This monograph is intended principally for malaria control workers in Venezuela and is adapted for the use of those who have not had experience in the identification of mosquitos. The history of the classification of Anophelines is summarised. The characters of the various subdivisions of the animal kingdom to which they belong are given briefly and also those of the two other subfamilies of Culicidae, the two other tribes of Culicinae, the genera *Anopheles*, *Chagasia* and *Bironella* and the American subgenera and groups of *Anopheles*. Notes are also included on classification and nomenclature, the construction of keys, the internal anatomy of mosquitos, the preservation of the various stages, and technique for obtaining eggs and infecting females in the laboratory. The Anopheline egg, larva (including chaetotaxy), pupa and adult are described, and general biological notes and instructions for collecting and rearing larvae and collecting adults are given.

The greater part of the book consists of descriptions of the larvae, adults and male terminalia of the Anophelines known to occur in Venezuela (29 species of *Anopheles* and *Chagasia bathanus*, Dyar). Keys and charts for separating the larvae, males, and females are included. Data are given on the year in which each was first recorded in Venezuela, the name of the worker who found it and its distribution within the country. The author considers *A. goeldii*, Rozeboom & Gabaldon, to be a synonym of *A. nuñez-tovari*, Gabaldon [*cf. R.A.E.*, B **29** 177, 180, 181]. He briefly reviews several references in the literature to the species of *Anopheles* that carry malaria in Venezuela, confirms that *A. pseudopunctipennis*, Theo., is a vector [*cf.* **17** 109; **22** 239], and concludes that the species chiefly responsible for transmission are *A. albimanus*, Wied. [**22** 239; **30** 190], *A. darlingi*, Root [**20** 9; **30** 190], *A. pseudopunctipennis* and *A. albitarsis*, Arrib. [*cf.* **17** 109; **23** 137]. *A. triannulatus davisi*, Paterson & Shann., has recently been found naturally infected.

Peus (F.). **Die Stechmücken und ihre Bekämpfung. Teil I. Die Fiebermücken des Mittelmeergebietes.** [Mosquitos and their Control. Part I. *Anopheles* of the Mediterranean Region.]—*Hyg. Zool.* **8** 150 pp., 170 figs., 2 fldg. keys, 15 refs. Leipzig, P. Schöps, 1942. Price, paper, *Rm.* 18.

This book deals with the identification by easily recognisable characters and with the biology of the various species of *Anopheles* of the Mediterranean Region. The characters used are defined in the first or general section, in which a full description is given of mosquitos in all stages, together with the distinguishing characters of the genus and brief accounts of classification and life-history. Definitions of the *Anopheles*, *Myzorhynchus* and *Myzomyia* types of wings are included. The second or specialised section opens with a definition of the area dealt with, which has the same southern and western limits as the Mediterranean Sub-region of the Palaearctic Region but extends rather further north and is limited on the east by the Caspian Sea and the Persian Gulf. Lists are given of the species occurring in the area and in the various parts of it. About half the book consists of descriptions of the adults of the various species and the larva and egg also if known, with notes on distribution, breeding places and habits, the importance of each in relation to malaria and their varieties, if any. Illustrated and ordinary keys to the females and larvae are included.

Papers noticed by Title only.

Damasceno (R. G.) & Causey (O. R.). **Estudo sobre *Flebotomus* no Vale Amazonico. Parte I. Descrição de *F. marajoensis*, *F. pilosus*, *F. souzacastroi* e *F. christophersoni* (Diptera : Psychodidae).** [A Study of *Phlebotomus* in the Valley of the Amazon. Part I. Description of *P. marajoensis*, *P. pilosus*, *P. souzacastroi* and *P. christophersoni*, spp. n.]—*Mem. Inst. Osw. Cruz* **41** fasc. 2 pp. 339–350, 5 pls., 5 refs. Rio de Janeiro, 1945.

Schuck (B. R.). **A new Locality for *Trypanosoma cruzi* [in *Triatoma longipes*, Barber, and *T. rubida*, Uhl.] in Arizona.**—*J. Parasit.* **31** no. 2 p. 151. Lancaster, Pa., 1945. [*Cf. R.A.E.*, B **24** 206; **32** 57, etc.]

Ginsburg (J. M.). **Chemical Methods for Analysis of Dichloro-diphenyl-trichloroethane (DDT).**—*J. econ. Ent.* **39** no. 2 pp. 174–177, 19 refs. Menasha, Wis., 1946. [*See R.A.E.*, A **35** 251.]

Del Vecchio (G.). **Fauna anofelica della provincia di Littoria e sua distribuzione. Nota I.** [Anophelines of the Province of Littoria and their Distribution. Note I.]—*R. C. Ist. Sanit. pubbl.* **4** pp. 614–659, 14 graphs, 22 refs. Rome, 1941. (With a Summary in Latin.) **Ricerche sull'anofelismo in provincia di Littoria. Nota II.** [Researches into Anophelism in the Province of Littoria. Note II.]—*R. C. Ist. Sanit.* **4** pp. 1020–1061, 12 graphs, 1 ref. (With a Summary in Latin.) **Modifiche della fauna anofelica dell'Agro Pontino. Nota I.** [Modifications in the Anopheline Fauna of the Pontine Territory. Note I.]—*Riv. ital. Igiene* **1** no. 11 repr. 17 pp., 3 graphs, 19 refs. Pisa, 1941. (With a Summary in Latin.)

The first of these papers comprises a detailed record of observations on Anophelines in the province of Littoria, Italy, in 1937–38, a brief account of most of which has already been noticed [*cf. R.A.E.*, B **27** 125].

In the second paper, similar observations are recorded for the year beginning 21st September 1938, during which 103 Anophelines were taken in dwellings and 31,409 in pig-sties and cow-sheds. Of the latter 21,818 were taken in the ten districts that comprise the Pontine region and 9,591 in the remaining eight districts of the province of Littoria, the percentages belonging to the species *Anopheles maculipennis*, Mg., being 92·8 and 77·1, respectively. The greatest numbers of Anophelines were caught during the months of October, June, July and August (3,588–5,156), and the least in March (532). Eggs were laid in captivity by 12,942 Anophelines from animal quarters and by 7 from houses; the former comprised 4,916 *A. maculipennis* var. *typicus*, 3,930 *A. m. labranchiae*, Flni., 1,440 *A. m. messeae*, Flni., 1,498 *A. claviger* var. *missiroli*, Del Vecchio, 1,139 *A. c. petragnani*, Del Vecchio, 14 *A. algeriensis*, Theo., 5 *A. hyrcanus* var. *pseudopictus*, Grassi, and 1 *A. plumbeus*, Steph., and the latter 2 *A. m. labranchiae*, 1 *A. m. typicus* and 4 *A. c. missiroli*. Vars. *typicus* and *labranchiae* were more numerous in Pontine territory than elsewhere, whereas var. *messeae* was very scarce in the Pontine region. Details are given of the numbers of each Anopheline caught in each district of the province, and graphs show the monthly oviposition figures. The curves for the varieties of *A. maculipennis* have a low peak in February and a very high one in June–July, while those for the other species have two approximately equal peaks, in autumn and spring. These observations confirm the view that in the province of Littoria, where the seasonal epidemic of malaria lasts from June to September, Anophelines of the *maculipennis* group are the vectors.

In the third paper the author reviews from the literature and the observations recorded in the first and second papers the way in which reclamation of the Pontine marshes between about 1926 and 1939 led to a reduction in the total numbers of Anophelines and to the gradual replacement of var. *messeae*, as the dominant form of *Anopheles maculipennis*, first by var. *labranchiae* and later, when the work was almost complete, by the typical variety, with a consequent great reduction in the incidence of malaria [*cf.* **27** 53]. Neither variety of *A. claviger* is of importance as a vector.

Brumpt (E.). **Etude morphologique et biologique de *Xiphidiocercaria polyxena* n. sp. produisant des infections mortelles chez les larves de Culicidés.**—*Ann. Parasit. hum. comp.* **20** no. 3–4 pp. 97–117, 7 figs., 30 refs. Paris, 1945.

Notes on the identification of cercariae are given, together with a description and information on the habits of *Xiphidiocercaria polyxena*, sp. n., sporocysts and cercariae of which were found in abundance in the snail, *Planorbis corneus*, in a drainage ditch in northern France in April 1928 and again in April 1929. The cercariae leave the snails by night and day, particularly at fairly high temperatures, are active and survived for up to 72 hours in water at 15°C.

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[59°F.]. The final host in nature and the adult Trematode form are not known. Encystment of the cercariae was observed in examples of *P. corneus* that contained no sporocysts and were living in the same breeding places as infected examples. It was obtained experimentally in various molluscs and the aquatic larvae of various insects, including mosquitos and *Chironomus plumosus*, L. Encystment was much more readily obtained in insect larvae than in molluscs. It does not normally occur on the surface of the hosts, but some cercariae encysted on the surface of larvae of mosquitos and *Chironomus* in a fluid that was exuded through the many wounds made by others in penetrating to the interior. Insect larvae move away rapidly when attacked and kill many of the cercariae with their mouth-parts, so that attacks by small numbers are probably overcome, but in experimental infections with large numbers of cercariae, fresh individuals replace those destroyed and the larvae are rapidly paralysed and killed by loss of blood and the action of the toxic substances secreted by the parasites. These secretions appear to be less toxic for molluscs.

Brumpt (E.). **Zooprophylaxie du paludisme.**—*Ann. Parasit. hum. comp.* **20** no. 3–4 pp. 191–206, 3 pp. refs. Paris, 1945.

In the introductory section of this paper, the author explains that the protection from malaria afforded to human populations by stabled animals depends on the preference of female Anophelines for shelters that provide warmth, humidity, darkness, protection from wind and an abundant food-supply rather than for a particular species of host, but that many species have been found to show zooprophilism even in the open air. He then discusses the formation of zoophilous races [*cf. R.A.E.*, B **26** 68–69] and reviews the literature on zooprophylaxis in relation to *Anopheles maculipennis*, Mg., and its various biotypes, and to other species of *Anopheles*.

African Coast Fever.—*Rhod. agric. J.* **42** no. 5 pp. 398–403. Salisbury, S. Rhod., 1945.

African coast fever of cattle [caused by *Theileria parva*], which was introduced into Southern Rhodesia in 1902 and became widespread, was cleared from most of the country by dipping to kill the ticks (*Rhipicephalus* spp.) that transmit it [*cf. R.A.E.*, B **15** 220], but persists in a few localities in the Melsetter district. Here it occurred on 84 farms between 1906 and 1944 and was eradicated from 54 and 23 on its first and second occurrences, respectively. Outbreaks recurred 3–6 times on six farms at intervals of three years or more, and the history of the disease on and near these farms is studied to examine the opinion that it is enzootic. It is concluded that some of the outbreaks were unsuccessfully dealt with and that infected ticks survived and spread to other farms. Infection must have persisted in ticks in the Melsetter district since 1906. This does not mean that the disease is enzootic, for there is no regular high mortality of young animals and systematic dipping keeps the numbers of infected ticks at a low level. It is considered that the disease in the remaining centres can be eradicated by dipping at short intervals, and it is essential to obtain fresh smears from all sick and dead cattle, so that the occurrence of the last case in an area is known.

Jellison (W. L.). **Siphonaptera : The Genus *Oropsylla* in North America.**—*J. Parasit.* **31** no. 2 pp. 83–97, 20 figs., 19 refs. Lancaster, Pa., 1945.

As *Oropsylla rupestris*, Jord., and *O. idahoensis*, Baker, were among the fleas found by Eskey & Haas to be experimental vectors of plague [*cf. R.A.E.*, B **28** 27], and as their hosts have been found infected with plague in the western United States and Canada, the adults of both sexes of the four American species

of *Oropsylla* are described, and data are given on distribution and host relationships. The few records available for *O. alaskensis*, Baker, indicate that it is restricted to the ground squirrels of the group of *Citellus parryii* of northern Canada and Alaska and even occurs within the Arctic Circle. *O. arctomys*, Baker, is a characteristic parasite of *Marmota monax*, and its distribution probably coincides with that of the several subspecies of *M. monax* from Massachusetts and New York across the north central United States to Briti h Columbia and Alaska. It only very rarely occurs on other species of *Marmota* beyond the range of *M. monax*. *O. rupestris* appears to be limited to *C. richardsoni richardsoni* and therefore to the north-western United States and south-western Canada. Two records from far outside the range of the host are questioned. *O. idahoensis* shows less host specificity than the other three species. It is found on a great many species of *Citellus* and also on *Cynomys*. It is the only consistent flea parasite of *Citellus* (*Callospermophilus*) *lateralis*, which occurs in the western States, British Columbia and Alberta, and its range roughly coincides with that of this ground squirrel except that it extends into Alaska. All species are occasionally found on rodents other than their normal hosts and frequently on predators within their range.

Addis (C. J.). *Phlebotomus* (*Dampfomyia*) *anthophorus*, **n. sp., and** *Phlebotomus diabolicus* **Hall from Texas (Diptera : Psychodidae).**—*J. Parasit.* **31** no. 2 pp. 119–127, 18 figs., 4 refs. Lancaster, Pa., 1945.

Both sexes of *Phlebotomus anthophorus*, sp. n., are described, the new subgenus *Dampfomyia* is erected for it, and supplementary descriptions are given of both sexes of *P. diabolicus*, Hall [*cf. R.A.E.*, B **24** 132]. Both species were taken in Texas, the former from June to November 1944 and again in March 1945 feeding on captive rabbits in the early morning, and the latter in May and June and from late September to November 1944 in and around dwellings and attacking man. A. Dampf records the collection of one female of *P. anthophorus* in a house in Cuantla in the State of Morelos, Mexico, in 1937. Attempts to feed this species on man in the laboratory failed. Both sexes have been reared from eggs laid in the laboratory, but no males were seen in nature. Six species of *Phlebotomus* are now known in the United States [*cf.* **33** 113, 128].

Webster (J. D.). **Intestinal Myiasis with** *Lucilia*.—*J. Parasit.* **31** no. 2 p. 151. Lancaster, Pa., 1945.

A single living third-instar larva of *Lucilia* sp. was passed on 2nd December 1943 by a man in Utah who gave a history of intermittent diarrhoea for six or seven months and recently the passage of "small worms." Hexylresorcinol was given on the same day, and several adults of *Ascaris lumbricoides* were later recovered but no more maggots.

Scott (O. K.), Richards (C. S.) & Seaman (E. A.). **Experimental Infection of Southern California Mosquitoes with** *Wuchereria bancrofti*.—*J. Parasit.* **31** no. 3 pp. 195–197, 2 figs. Lancaster, Pa., 1945.

Men returning to the United States from the South Pacific war area showing early-stage infection with *Filaria* (*Wuchereria*) *bancrofti* have practically never had microfilariae demonstrable in the blood stream, and in view of the shortness of their exposure, it is doubtful whether any of them ever will have. It was nevertheless considered desirable to determine whether any of the mosquitos of the hitherto uninfected parts of the country could transmit *F. bancrofti*, and the ability of the common mosquitos of the San Diego area, California, to do so was accordingly investigated by allowing them to feed on a man with microfilariae

in the blood. The species tested were *Anopheles maculipennis freeborni*, Aitken, *A. pseudopunctipennis*, Theo., *Aëdes taeniorhynchus*, Wied., *Culex fatigans*, Wied. (*quinquefasciatus*, auct.), *C. erythrothorax*, Dyar, *C. tarsalis*, Coq., *C. stigmatosoma*, Dyar, *Culiseta inornata*, Will., and *C. incidens*, Thoms. The last three would not feed, and neither of the species of *Anopheles* became infected. Only seven females of the first species and one female of the second fed; it is concluded that they are unlikely vectors. Infective filarial larvae developed in 15–16 days in *Culex fatigans*, *C. erythrothorax* and *C. tarsalis* and reached the proboscis. Of the 42 females of *Aëdes taeniorhynchus* that fed on the infected subject, only four survived until the 17th day, which was the day on which females were usually examined. These four were negative, and only ten of the other 38 had developing larvae when they died. The test was therefore inconclusive with regard to this species.

[Serdyukova (G. V.).] **Сердюкова (Г. В.). On the Cycle of Development of the Tick** *Hyalomma anatolicum anatolicum* **Koch.** [*In Russian.*]—*Bull. Acad. Sci. URSS* Sér. biol. 1946 no. 2–3 pp. 199–202, 10 refs. Moscow, 1946. (With a Summary in English.)

Various workers have found that *Hyalomma dromedarii*, Koch (*yakimovi*, Olen.), *H. anatolicum*, Koch (typical form) and *H. asiaticum*, Schulze & Schlottke, which are normally three-host ticks, can complete their development on one or on two hosts only [*cf. R.A.E.*, B **21** 32; **26** 58; **32** 86]. In experiments by the author in the Hissar Valley, western Tadzhikistan, larvae of the typical form of *H. anatolicum* from the same batch of eggs engorged on a rabbit, which is an unusual host for this tick, and though some thereupon detached themselves, others moulted on the animal. Some of the resulting nymphs wandered on the rabbit without feeding, but others engorged and then dropped off. Larvae placed on the ears of a calf all detached themselves after engorging, and no engorged or moulting larvae or larval exuvia were observed on calves in the field. Ticks collected in a calf shed included freshly engorged and moulting larvae and unfed nymphs. It is concluded, therefore, that *H. anatolicum* develops as a three-host tick on its normal host, but that an unusual host may alter this behaviour.

The cycle of development of Ixodids has probably altered as a result of evolutionary processes. The type of development that occurs on the usual host should be considered as the normal one and deviations from it on unusual hosts as atavistic.

[Pavlovskiĭ (E. N.).] **Павловский (Е. Н.). The Dynamics of Blood-sucking Diptera, and Methods and Importance of Studying it.** [*In Russian.*]—*Bull. Acad. Sci. URSS* Sér. biol. 1946 no. 2–3 pp. 211–232, 20 figs., 16 refs. Moscow, 1946. (With a Summary in English.)

In this paper, which is introductory to the four that follow, the author emphasises the necessity of using quantitative methods for studying the specific composition and daily or seasonal frequency of the blood-sucking Diptera that attack man and domestic animals in the Soviet Union, particularly those that transmit disease. He reviews the methods that have been employed by different workers there and the results obtained [*R.A.E.*, B **23** 3; **31** 72; **32** 214; **33** 183, 185; **34** 41, 73, 78], and considers that the best results are given by collecting the insects that settle on a man sitting unprotected in the open air for periods of 20 minutes at various times of the day [*cf.* **33** 185], and by collecting those that are enclosed when a bell-shaped cover is lowered over a man wearing protective clothing and sitting in the open [*cf.* **32** 214]. The latter method is well adapted for use at night.

[Monchadskiĭ (A. S.).] **Мончадский (А. С.). Activity of Mosquito Attacks against Man as observed under natural Conditions.** [*In Russian.*]—*Bull. Acad. Sci. URSS* Sér. biol. 1946 no. 2–3 pp. 233–250, 38 refs. Moscow, 1946. (With a Summary in English.)

Investigations by various workers (mainly Russian) on the times of the day at which Anopheline and other mosquitos attack man and on the factors that affect their activity are summarised. Much of the information has already been noticed [*cf. R.A.E.*, B **27** 220; **28** 119; **29** 202; **32** 166, 184, 214; **33** 47], and some is based on the three papers that follow. The effects on the behaviour of mosquitos of temperature, atmospheric humidity, wind and light are discussed at length, with examples from the literature, and it is concluded that temperature affects mosquito activity more than any other factor. Light is next in importance, but bright daylight and even direct sunlight do not reduce the intensity of attack if the temperature approaches the optimum.

The daily rhythm in activity, consisting of alternating periods of attack and rest, is the result of regular meteorological changes connected with the alternation of day and night. The typical daily rhythm in a temperate climate is characterised by attacks made chiefly at night, but it changes with the season of the year and with local temperatures. The close connection with temperature is broken at and just after sunset, when a sharp increase in activity is caused by the rapid transition from light to darkness. This increase can be checked or even prevented by wind but not by temperature, unless it is too low for any activity at all. The daily rhythm also varies with distance from day-time shelters. In places far from such shelters, the evening attacks start late and are of short duration; there are few or no attacks in the second half of the night or the early morning, and, except in early spring and late autumn, no attacks at all during the day.

[Bregetova (N. G.).] **Брегетова (Н. Г.). Activity in attacking Man and the Day Rhythm of *Aëdes caspius caspius* (Pall.) Edw. and *Aëdes vexans* Meig. as observed under natural Conditions of South Tadjikistan.** [*In Russian.*]—*Bull. Acad. Sci. URSS* Sér. biol. 1946 no. 2–3 pp. 251–279, 17 figs., 17 refs. Moscow, 1946. (With a Summary in English.)

An account is given of observations carried out from 14th July to 22nd September 1943 in two localities on the lower Pyandzh, in southern Tadzhikistan, where the insects that settled on members of the expedition were collected under a bell-shaped cover [*cf. R.A.E.*, B **32** 214] at various times of the day and night. Of the ten species of mosquitos taken in this way, about 70 per cent. in one locality and 89 per cent. in the other were *Aëdes caspius*, Pall. (typical form) and *A. vexans*, Mg. The others, which occurred in small numbers, included *Anopheles pulcherrimus*, Theo., *A. hyrcanus*, Pall., and *A. superpictus*, Grassi.

Aëdes caspius was commonest near human dwellings and outhouses, whereas *A. vexans* preferred a wild habitat. The catches showed that tempe ature is the principal factor affecting the incidence of attack. Both species were active at temperatures of 10–34°C. [50–93·2°F.], but *A. caspius* was most active at 25–30°C. [77–86°F.] in summer, and at 17·5–25·5 [63·5–77·9°F.] in au:umn, and the corresponding figures for *A. vexans* were 16–28°C. [60·8–82·4°F.] and 19–25°C. [66·2–77°F.]. These differences are in accordance with the geographical distribution of the two species, *A. caspius* being found in the steppe, semi-desert and desert zones, while *A. vexans* is widely distributed in the more northerly zones of the forest-steppe and forest. Attacks reached their peak in calm weather and decreased progressively with the strength of the wind, ceasing almost completely when the wind velocity exceeded 2·2 miles per hour in the case of *A. vexans* and when it was between 4·5 and 6·7 m.p.h.

in that of *A. caspius*. Relative humidity had little effect, since attack occurred at both 25 and 85 per cent.

The intensity of light by itself did not influence activity, and attack took place in bright sunlight, provided that the temperature was favourable, but the increase in activity that occurred after sunset indicated a stimulating effect of the reduced illumination. Moonlight and atmospheric pressure had no effect on attacks by either species. Their daily rhythm of activity comprised rest during the day and feeding in the evening, at night and in the morning.

[Krokhina (M. F.).] **Крохина (М. Ф.). Activity in attacking Man and Day Rhythm in *Anopheles pulcherrimus* Theob.** [*In Russian.*]—*Bull. Acad. Sci. URSS* Sér. biol. 1946 no. 2–3 pp. 281–298, 3 figs., 10 refs. Moscow, 1946. (With a Summary in English.)

The investigations described were carried out from July to October 1943 at three ecologically different points on the lower Pyandzh, in southern Tadzhikistan. Collections of mosquitos seeking to attack man were made under a bell-shaped cover [*cf. R.A.E.*, B **32** 214] and were supplemented by catches in a cattle shed. Anophelines represented only a small percentage of all the mosquitos taken, of which *Aëdes caspius*, Pall., and *A. vexans*, Mg. [*cf.* preceding abstract] were the commonest; they comprised, in order of decreasing abundance, *Anopheles pulcherrimus*, Theo., *A. hyrcanus*, Pall., and *A. superpictus*, Grassi. Up to mid-September, *A. pulcherrimus* constituted 79·9 per cent. of all the mosquitos taken in the cattle shed; it was moderately abundant in the open close to dwellings, but rare near the river. *A. hyrcanus* did not occur in the cattle shed and was commonest in the field in July. *A. superpictus* became abundant in the cattle shed towards the beginning of October, when it formed 50·8 per cent. of all the mosquitos present, but was scarce in the open.

Temperature was the chief factor affecting the activity of unfed females of *A. pulcherrimus* in the open. During the first half of the period, when the mean daily temperature was 17–38·5°C. [62·6–101·3°F.], attacks occurred at 17–33·5°C. [62·6–92·3°F.], with a peak at 25–27°C. [77–80·6°F.], but during the second, when it was 9·5–35°C. [49·1–95°F.] they occurred at 12–27°C. [53·6–80·6°F.], with a peak at 22–24°C. [71·6–75·2°F.]. The optimum temperature probably lies between 19 and 28°C. [66·2–82·4°F.]. Wind of a speed of about 2·2 miles per hour halved the number of females seeking a blood-meal, and a velocity of about 6·7 m.p.h. caused a practically complete cessation of activity.

Neither the atmospheric pressure, which fluctuated between 28·3 and 29 ins., nor the relative humidity, which varied from 10 to 80 per cent., had any effect on activity.

The influence of light intensity was not studied in detail, and although attacks were confined to the period between sunset and sunrise, it is considered that they probably occur during the day also at seasons of low night temperatures. The occurrence of sunset and twilight appeared to incite the mosquitos to feed, and temperature then became subsidiary, but the severity of attack at night was closely correlated with temperature, decreasing as it became lower. Moonlight had no influence.

The daily rhythm in the behaviour of *A. pulcherrimus* involved two principal periods of feeding, the main one in the evening and the other in the very early morning, separated by a period of inactivity during the day and of reduced feeding at night. The duration of the periods changed with temperature.

[Monchadskiĭ (A. S.).] **Мончадский (А. С.). Activity in attacking Man and Day Rhythm of *Mansonia richiardii* Fic. (Diptera, Culicidae).** [*In Russian.*]—*Bull. Acad. Sci. URSS* Sér. biol. 1946 no. 2–3 pp. 299–323, 6 figs., 10 refs. Moscow, 1946. (With a Summary in English.)

Mansonia richiardii, Fic., is abundant and aggressive in Central Asia, where it finds favourable breeding places in lakes and in stagnant water along the

middle and lower reaches of rivers and has three overlapping generations a year. The adults of the overwintered generation appear in May and those of the other two during July and August, respectively. Some larvae of the second generation and all those of the third hibernate. The adults are most abundant in the second half of August, but decrease with the onset of cold nights, and have apparently died out by the beginning of October.

Catches of mosquitos seeking to attack man in the open showed that *M. richiardii* was the predominant species in a village on the lower Vakhsh in 1942 [*R.A.E.*, B **32** 214] but not at several points on the lower Pyandzh in 1943 [see two preceding abstracts]. The relative scarcity of other mosquitos on the Vakhsh was apparently due to the destruction of their larvae by *Gambusia affinis holbrooki*, which had been introduced there several years before. It does not destroy the larvae and pupae of *M. richiardii*, because they live submerged on the stems of aquatic plants.

The absolute limits of the temperatures at which *M. richiardii* attacked man were 7 and 33°C. [44·6 and 91·4°F.], but the local range varied with the prevailing temperature and the season. Thus, on the Vakhsh, attack in summer was most intense between 13 and 21°C. [55·4–69·8°F.] and eached a peak at 16–18°C. [60·8–64·4°F.], whereas in one place on the Pyandzh, one of the hottest and driest in southern Tadzhikistan, intense attacks occurred at 22–30°C. [71·6–86°F.], with a peak at 25–27°C. [77–80·6°F.]. In autumn, the thermal limits of activity became lower. Relative humidity had no effect on behaviour, since the mosquitos were most active at a humidity of 70–80 per cent. in one place and at 20–30 per cent. in another. The numbers taken were more than twice as great in the absence of wind as at wind velocities of 0·2–1·1 miles per hour, and none was taken in winds of over 6·7 m.p.h. Daylight and even direct sunlight did not by themselves affect attack, but the rapid onset of darkness after sunset had a stimulating effect irrespective of temperature or relative humidity. Moonlight had no effect, and fluctuations in atmospheric pressure were too slight to permit conclusions.

The daily rhythm of activity of *M. richiardii* at a given point depended to a considerable extent on temperature but also varied with the season and the distance of the site of observation from the day-time shelters of the mosquitos amongst dense vegetation on the river banks. The intensity of attack in the evening and the early morning was inversely proportional to the distance from these shelters, and, except in autumn, attack during the day was confined to their immediate vicinity. In summer, mass attacks took place after sunset, the peak being reached between 9.30 and 11.30 p.m., and again after sunrise, with a peak between 8 and 9 a.m. With the onset of cold nights in autumn, evening activity began and finished earlier and the morning attack began later.

KOZHANCHIKOV (I. V.). **On the lower thermal Limit in the Development of Insects.**—*C. R. Acad. Sci. URSS* (N.S.) **51** no. 3 pp. 241–244, 1 graph, 12 refs. Moscow, 1946.

In order to study certain aspects of the theory of thermal thresholds of development in insects, the effect of temperature on the development of pupae of *Musca domestica*, L., was investigated. When the pupae were kept at constant temperatures, none survived at 10 or 36°C. [50 or 96·8°F.], and the duration of development ranged from 36–37 days (with 85 per cent. mortality) at 13·5°C. [56·3°F.] to 4 days (with 12 per cent.) at 34·5°C. [94·1°F.]. There was no mortality at 20 or 25°C. [68 or 77°F.], at which development was completed in 8·7 and 6 days, respectively. Pupae kept at temperatures of 0–5°C. [32·41°F.] for 1–10 days and then at 25°C. completed their development at the higher temperature in about 6 days, but if the initial temperature was 10°C., the subsequent development period was slightly reduced when the exposure period lasted 1–2 days but increased when it lasted 3–6 days. In general,

mortality increased with the duration of exposure to the lower temperature. The author concludes that there is a thermal threshold a little above 5°C. below which developmental processes cease completely, and a thermal limit a little above 10°C., below which they continue, but are not completed ; the thermal limit is set by the exhaustion of the organism and the disturbance of the processes of development caused by low temperatures. In discussing his results with reference to the acceleration of development recorded by various investigators at alternating temperatures [*cf. R.A.E.*, A **29** 131 ; B **33** 82], the author states that the period of development was shorter where the high temperature followed a low one than at the constant temperature corresponding to the average between them only where the low temperature was below the thermal limit, and that it was the same or longer where the low temperature was above the limit.

GIRARD (H.) & ROUSSELOT (R.). **La rickettsiose bovine à** *Rickettsia bovis* **au Soudan français.**—*Bull. Soc. Path. exot.* **38** no. 3–4 pp. 64–77, 1 fig., 19 refs. Paris, 1945.

The laboratory infection caused in cattle by *Rickettsia bovis* in 1936 [*R.A.E.*, B **25** 123] was characterised by an incubation period of 14–15 days, an irregular temperature curve exceeding 40°C. [104°F.], weakness and loss of weight, but was never fatal. The parasites occurred in the mononuclear leucocytes only. Cross immunity tests showed the disease to be quite distinct from heartwater [caused by *R. ruminantium*]. Infection by *R. bovis* was later shown to be frequent in Algeria, where it appeared to have very slight pathological significance, but it was recorded in cattle in South Africa in 1937 and in bovines in Chad and the French Congo in 1939, and was subsequently found to be the cause of a serious and often fatal disease of cattle in the French Sudan. An account is given of the identification symptoms, effects, and attempted treatment of this disease, of which there are both chronic and acute forms. It is usually sporadic, but outbreaks occurred in the rainy seasons of 1942 and 1943. The rickettsiae were found in chronic carriers. Inoculation of infected blood into healthy animals caused inapparent infection only, and experiments on transmission through the agency of ticks found on sick animals gave the same result. No attempt was made in these tests to differentiate between the kinds of ticks found, which were mostly of the genus *Hyalomma* but included also *Amblyomma variegatum*, F., and *Rhipicephalus evertsi*, Neum. During the first outbreak, mortality fell considerably some time after the cattle first passed through an anti-tick dip. Herds kept near the infected one and dipped regularly did not contract the disease.

PIROT (R.) & BOURGAIN (M.). **Perte du pouvoir infectant d'***Ornithodorus tholozani* **infecté congénitalement par** *Spirochaeta persica* **et surinfecté au stade nymphal.**—*Bull. Soc. Path. exot.* **38** no. 3–4 pp. 88–90, 4 refs. Paris, 1945.

Since 1940, the authors have maintained a strain of *Spirochaeta persica* of Persian origin in *Ornithodoros tholozani*, Lab. & Mégn. It apparently closely resembles the strain called *S. sogdiana* by Nicolle & Anderson [*R.A.E.*, B **17** 18]. It causes a typical relapsing fever in guineapigs, rabbits and rats, but is never fatal and never causes hypertrophy of the spleen in guineapigs. Infection in guineapigs confers definite immunity against the same strain for 3–7 months. A sample from a batch of 600 larvae newly hatched from eggs laid by various females on 3rd June 1940 was shown by injection to be infective. In July, 60 newly moulted nymphs of this batch were fed on an infected guineapig. They were subsequently fed after each moult on a healthy guineapig, and infectivity was thus demonstrated in each instar and in the adult stage, which

was reached in May 1942. The batch of 26 adults surviving in September 1943 was still infective, but guineapigs on which the adults engorged in November and one on which the remaining 18 fed four months later did not acquire the infection. This loss of infectivity is discussed. It is possible that all individuals were not originally infected and that those that were did not live as long as the others. The ticks were not always kept at a temperature above 20°C. [68°F.], but this is not considered a likely cause of the loss of infectivity.

ROUBAUD (E.). **Résistance au jeûne hibernal chez le moustique commun *Culex pipiens* L.**—*Bull. Soc. Path. exot.* **38** no. 3–4 pp. 105–111, 5 refs. Paris, 1945.

The following is based on the author's summary. Females of the different sub-divisions, both autogenous and non-autogenous, of the group of *Culex pipiens*, L. [*cf. R.A.E.*, B **35** 119] can subsist much longer without food in saturated than in dry air. At about 15°C. [59°F], they can survive several weeks without a blood-meal or sugar if they have a constant supply of water, but individual differences are considerable, and only members of the rural biotype, *C. p. pipiens*, can survive under these conditions for several months. This prolonged resistance corresponds to normal overwintering in this form [*loc. cit.*], and occurs only in certain generations [*cf.* **21** 267, etc.]. It is linked with the intense development of the fat-body and depends on a cessation of the maturation of the ovaries. Females of *C. p. berbericus*, Roub., from the south of France can survive without food in a damp atmosphere for more than a month, but do not have the power of winter fattening and do not undergo a period of ovarian diapause. Hibernation in this form depends entirely on temperature. This applies also to females of *C. autogenicus*, Roub., which develop their ovules and not their fat reserve if left without food in a damp atmosphere. They can withstand a fairly long period without food, especially if they are not in a condition to oviposit, but the survival of the species from one season to another by means of winter rest seems to be exceptional, as reproductive activity usually continues in winter in the warm, subterranean shelters that it frequents [**30** 160 etc.].

ROUBAUD (E.) & COLAS-BELCOUR (J.). **Le froid et les facteurs d'éclosion de l'oeuf chez l'*Aëdes geniculatus* Oliv.**—*Bull. Soc. Path. exot.* **38** no. 3–4 pp. 111–118, 1 fig., 5 refs. Paris, 1945.

An account is given of experiments showing that hatching of eggs of *Aëdes geniculatus*, Ol., can be induced by various physical, chemical and mechanical stimuli, but that the response is slight if the eggs have not previously undergone a latent period of some months' duration under either dry or damp conditions. Eggs submitted for a long time to temperatures of 0–12°C. [32–53·6°F.] responded more readily to the usual stimuli than others that had not been exposed to cold. The reactions of eggs of *A. geniculatus* are thus approximately the same as those recently demonstrated in *A. caspius*, Pall. [*R.A.E.*, B **35** 58], also a species belonging to temperate and cold regions.

ROUBAUD (E.) & COLAS-BELCOUR (J.). **Influence de la salure des eaux sur le développement de l'*Aëdes aegypti*.**—*Bull. Soc. Path. exot.* **38** no. 5–6 pp. 136–145, 12 refs. Paris, 1945.

From laboratory experiments described, it appeared that tap water and pure and diluted sea water all attracted males and females of *Aëdes aegypti*, L., and no marked preference for any particular medium was noticed. The only influence involved appeared to be hygrotropism. Ovipositing females, however, showed preferences for certain kinds of water. Of the 17,940 eggs laid,

28·9 per cent. were deposited on tap water, 28, 22·2 and 17·8 per cent., respectively, on water containing an added 31, 42·6 or 62 per cent. sea water and 3·1 per cent. on undiluted sea water. The eggs were often laid on the surface of the water and not on the sides of the flasks. Many of the eggs deposited in sea water remained whitish and the chorion did not harden. Two forms of tropism thus appear to be involved in the choice of a medium for oviposition. The attraction of the females to the water surface, which seems to be hygrotropism affecting males and females alike, and a hypothetical reflex peculiar to gravid females and apparently governed by a special sensibility of the tip of the abdomen with regard to unfavourable substances in the medium.

BOURGAIN (M.). **Sur un exemplaire de** *Phlebotomus papatasi* **Scopoli, 1786, capturé à Toulon.**—*Bull. Soc. Path. exot.* **38** no. 5–6 pp. 145–149, 1 fig., 2 refs. Paris, 1945. **Contribution à l'étude des phlébotomes du littoral méditerranéen français: présence de** *Phlebotomus* (*Brumptius*) *parroti* **Adler et Théodor 1926, aux Darboussèdes (banlieue de Toulon).**—*T.c.* pp. 150–158, 1 fig., 13 refs.

In the first paper, it is stated that sandfly (three-day) fever is becoming established on the Mediterranean coast of France, that cases occurred in Toulon in August 1944, and that a male of *Phlebotomus papatasii*, Scop., was found at Toulon in October. The specimen, which had a slight anomaly in the wings, is described. References in the literature to the occurrence of each of the six French species of *Phlebotomus* [*R.A.E.*, B **20** 161] in the Mediterranean coastal area of the country are cited in the second paper, and it is recorded that collections of *Phlebotomus* made in a Toulon suburb in July 1944 included 14 individuals of *P. perniciosus*, Newst., which had previously been recorded from the town, and 82 of *P. minutus* var. *parroti*, Adl. & Thdr., which is a new local record. Both sexes of the latter are described.

STAMMERS (F. M. G.) & WHITFIELD (F. G. S.). **The Toxicity of DDT to Man and Animals. A Report on the Work carried out at the Royal Naval School of Tropical Hygiene, Colombo, and a Review of the World Literature to January 1947.**—*Bull. ent. Res.* **38** pt. 1 pp. 1–73, 5½ pp. refs. London, 1947.

The investigations described from Colombo were made on a team of 15 men, ten employed continuously for nine months and five for seven months on spraying a 5 per cent. solution of DDT, with an average of about 75 per cent. of the p,p′ isomer, in kerosene under operational conditions. The solution was prepared by members of the team, and knapsack sprayers were used. Protective clothing was issued, but was discarded by the men except for the overalls, which they wore open at the neck and usually with the sleeves rolled up. They washed their hands before the midday meal, and most washed all over at the end of the day under a cold-water tap in the open. Much of the work being in confined spaces, they were frequently working in a saturated atmosphere, and many of the sprayers leaked. The hands, arms and to some extent the faces and feet of the operators were constantly exposed to spray dripping from ceilings and splashing from walls. After a day's operations, a white frost of DDT crystals could be seen on the exposed parts of the skin, while the overalls were often saturated. In the tabulation of data, contamination is graded in five classes ranging from appreciable to gross and depending on the spraying time, the amount of insecticide used, the nature and degree of infestation and the nature of the environment. Even when it was graded as only appreciable, hands, forearms and backs were usually soaked. The details of work carried out are given in tables, of which one shows the types of locality (ships, camps, barracks, etc.), objects treated (walls, furniture, etc.), the nature and degree of

infestation, the quantity of insecticide applied, the number of operators and the spraying time for various operations grouped according to the degree of exposure of the operators to DDT, and another shows the relation between the type of locality, the degree of exposure to DDT and the nature and degree of infestation. There is also a summary of operational data in relation to the degree of exposure. During the nine months, 175 spraying operations were carried out involving the use of 9,402 gals. spray with a total spraying time of 566 hours. Details are given of the medical examination of the men made after exposure had ceased. It is concluded that the clinical and special investigations and the demeanour and output of the men, who had been exposed for many months to heavy and regular contamination, considerably greater than any about which data have so far been published, indicated that they suffered no ill effects. They were keen on their work and seldom absented themselves.

Tests were also made in England of the toxicity to man and animals of a continuous-phase aerosol of DDT produced by electrical volatilisation. It was tested under conditions of normal and supra-normal insecticidal control. For the latter, men spent 27½ hours over a period of five days in a heavily treated room with restricted ventilation. In one of the tests under normal conditions, the aerosol-dispensing unit was run continuously day and night for three months in an office used by two persons. The animals were exposed continuously for 28 days. Under no circumstances during any of the tests were there any indications of toxicity to man or the test animals (guineapigs, rats and rabbits).

A summary of the literature on the results of various types of exposure of man and animals to DDT is given in tabular form. It is divided into two sections dealing, respectively, with cases where there were no harmful effects and cases where poisoning occurred, sometimes with fatal results. The data include the type and formula of the DDT, the dosage, method and purpose of its application, and remarks. The data on cases of toxicity to laboratory animals are further analysed according to solvent or carrier, dosage, type of exposure and lethal dose. The evidence is discussed, and it is concluded that DDT, when used as an insecticide with reasonable intelligence and the precautions normal in the use of modern insecticides, is harmless to man and animals. It is possible to incur risk by unskilled use. Attention is drawn to the fact that animals eating forage crops sprayed with DDT transmit the poison in milk and store significant quantities in the meat, particularly the fat.

Busvine (J. R.) & Barnes (S.). **Observations on Mortality among Insects exposed to dry insecticidal Films.**—*Bull. ent. Res.* **38** pt. 1 pp. 81-90, 3 refs. London, 1947.

A method of impregnating filter papers with solutions calculated to give standard deposits of solute per unit area after the evaporation of the solvent is described, and the results are given of tests of insecticides made by confining Arthropods for various periods on papers so treated with them. The Arthropods used were nymphs and adults of *Ixodes ricinus*, L., nymphs of *Ornithodoros moubata*, Murr., nymphs and adults of *Rhodnius prolixus*, Stål, adults of *Cimex lectularius*, L., *Blatta orientalis*, L., *Pediculus humanus*, L., *Musca domestica*, L., *Aëdes aegypti*, L., *Calandra granaria*, L., and *Tribolium confusum*, Duv., and larvae of *Tenebrio molitor*, L. The insecticides were pure p,p′ DDT, pure γ benzene hexachloride [GBH], a pyrethrum concentrate containing 20 per cent. pyrethrins, and crystalline rotenone. With a standard exposure of two hours at 30°C. [86°F.] to freshly prepared films, GBH, pyrethrins, DDT and rotenone were toxic in that order, the deposits necessary to give 50 per cent. kill being estimated as 0·00001–1·0, 0·0006–1·0, 0·0005–10·0, and 2 to more than 10 mg. per sq. cm., respectively, according to species. The larvae of *Tenebrio* were much more resistant than any of the other Arthropods except to DDT, to which *Rhodnius* and *Ornithodoros* were equally so. *Blatta*,

Tribolium and *Calandra* were resistant to DDT and pyrethrins, but the first two were susceptible to GBH. *Pediculus* was similar, but much more susceptible to GBH. *Rhodnius*, *Cimex* and *Ornithodoros* were resistant to DDT but susceptible to GBH and pyrethrins, *Musca* and *Aëdes* were very susceptible to GBH, pyrethrins and DDT, and *Ixodes* also was sensitive to DDT and pyrethrins. Comparison of median lethal doses of GBH, DDT and pyrethrins in these tests with those of the same insecticides applied as sprays in oil solution showed that the relationships are quite different as regards magnitude, and sometimes even order, of toxicity. The very sparse toxic films of GBH soon lost their toxicity, apparently by evaporation. The pyrethrin films were also less persistent than those of DDT, which retained their power for at least three weeks.

Other tests were carried out at room temperature, and in some of them the treated filter paper was further impregnated with 4-chlor-2-methyl-phenol to give a deposit of 0·0025 mg. per sq. cm., the irritant effect of which [*cf. R.A.E.*, B **32** 46] kept the insects moving frequently without injuring them. Percentage mortality among bugs (*Cimex*) kept in motion for a specified period over a given deposit of DDT was generally greater than that among stationary bugs exposed to the same deposit for the same period. The addition of an irritant to a DDT spray would therefore enhance its efficiency. For each DDT deposit, the percentage mortality among bugs increased as the time of exposure increased from five to 45 minutes, but the difference in percentage kill among bugs exposed for one hour and 24 hours was negligible. Complete kill was achieved only after exposure for four days to the heaviest deposit (5 mg. per sq. cm.) and seven days to the lighter ones. When stationary bugs were exposed to GBH or moving lice (*Pediculus*) or flour beetles (*Tribolium*) to DDT, percentage mortality increased progressively with the time of exposure. Percentage mortality among bugs exposed intermittently to DDT for a given total period of exposure did not differ appreciably from that obtained among bugs exposed continuously for the same period.

THEODOR (O.). **On some Sandflies** (*Phlebotomus*) **of the** *sergenti* **Group in Palestine.**—*Bull. ent. Res.* **38** pt. 1 pp. 91–98, 4 figs., 16 refs. London, 1947.

Sinton [*R.A.E.*, B **15** 206] questioned the identification by Adler & Theodor [**13** 175] of the vector of dermal leishmaniasis [*Leishmania tropica*] in Palestine as *Phlebotomus papatasii*, Scop., and suggested that the species they used in their experiments was actually *P. sergenti*, Parr. The author points out, however, that *P. papatasii* has subsequently been shown to be a vector of the disease [**17** 149; **30** 135] and that *P. sergenti* is very rare in Palestine, its occurrence not having been proved until December 1946, when one female was found in a cave in Wadi Fukra about 9½ miles south of the Dead Sea. It did not occur among several thousand sandflies examined from settlements near the northern end of the Dead Sea and from Jericho. Its relative rarity in Syria makes it unlikely that it plays any part in the transmission of dermal leishmaniasis in the endemic foci examined except in Aleppo, where it is as common as *P. papatasii* and both are probably vectors.

Descriptions are given of the male of *P. jacusieli*, sp. n., and both sexes of *P. maris-mortui*, sp. n., and *P. palestinensis*, Adl. & Thdr., all from Palestine. Differences in the characters of *P. alexandri*, Sinton, in the various areas in which it occurs, including Palestine, where it is recorded from the first time, are discussed.

MACINNES (D. G.). **On the Effect of DDT-treated Surfaces on Adults of** *Anopheles gambiae* **and** *A. funestus.*—*Bull. ent. Res.* **38** pt. 1 pp. 123–130, 1 fig., 2 refs. London, 1947.

The observations described concerned problems arising from the practical application of DDT against larvae of *Anopheles gambiae*, Giles, and *A. funestus*,

Giles, and were made at Taveta, Kenya, between January and April 1946. It had been observed at Kisumu, Kenya, that a reduction of 98 per cent. in the adult population of malaria vectors occurred within three days of the first application of a larvicidal spray of DDT in oil at 32 mg. pure DDT per sq. metre, whereas catches of adult vectors in a sprayed area at Dar-es-Salaam, Tanganyika, were not immediately reduced after the application of a similar spray at 17 mg. pure DDT per sq. metre, though the anticipated seasonal rise did not occur. When females of *A. gambiae* and *A. funestus* were confined in cages with a bowl of water, to the surface of which an oil solution of DDT had been applied, there was appreciable mortality, which was greatest among ovipositing females, but to some extent involved those in earlier stages of ovarian development also. DDT in solution in a heavy oil film of long persistency had the greatest effect. The presence of a solution of DDT on the water, particularly a heavy oil solution, appeared to reduce oviposition appreciably.

An experiment designed to determine the period of exposure necessary for an adult mosquito to acquire a lethal dose of DDT was undertaken in view of the finding that females of *A. gambiae* could lay a normal complement of eggs within 5 minutes. Exposure of females of *A. gambiae* and *A. funestus* for 60 minutes in a box with sides of smooth wood bearing a film five months old of 200 mg. DDT per sq. ft. had killed 22 per cent. at the end of the period and 100 per cent. three hours later. None was killed immediately by exposure for five minutes, but 17 per cent. were dead within three hours, and 73 per cent. at the end of 12 hours. Intermediate periods of exposure gave corresponding kill. These results are compared with those obtained with *A. quadrimaculatus*, Say, in the United States [*R.A.E.*, B **34** 129].

Females of *A. gambiae* and *A. funestus*, exposed in communicating treated and untreated net cages showed characteristic restlessness as a result of contact with a surface treated with DDT. When they were inserted first into a treated cage and after five minutes allowed access to an untreated cage, higher mortality was recorded than when the procedure was reversed. The degrees of mortality and restlessness seemed to be closely connected. Repellency appeared negligible.

HOCKING (K. S.). **Assessment of Malaria Control by Mosquito Prevalence.**—*Bull. ent. Res.* **38** pt. 1 pp. 131–136, 3 figs. London, 1947.

The effectiveness of malaria control by measures against Anophelines is assessed ultimately from the number of cases contracted in the treated area, but a method of assessment that gives more immediate and definite information is required because of the delay involved in depending on case incidence, and the errors introduced by shifting populations, relapses not recognised as such, and the lack of cases despite infection in a predominantly immune community in which non-immune persons are protected by suppressive drugs. Hand-catching of adult mosquitos at stations (native huts, servants' quarters or tents) distributed in the centre and at the edge of the control area and outside it has been widely used for six years to assess the effectiveness of operations in East Africa. Trained catchers collect the mosquitos weekly from each station during the morning, using test tubes and an electric torch. When *Anopheles gambiae*, Giles, and *A. funestus*, Giles, are the main vectors, it is necessary to use human bait. To illustrate the value of the method, the numbers of females of vector species per house and the numbers of malaria cases per thousand are shown for most months of the years 1943–45 for Nairobi, Kenya, for Dar-es-Salaam, Tanganyika, and for Diego Suarez, Madagascar. Correlation was found between the two sets of figures. In Nairobi, it was highly significant between catches and malaria cases one month later, and in the warmer climates of the other localities between catches and cases two weeks later. Thus, the catches generally gave an

assessment of the efficiency of control that is as reliable as that given by malaria incidence and more prompt. Control in the centre of the treated area appeared to be about 95 per cent. and at the edge about 50 per cent. As it is sometimes impossible to find suitable catching stations, native huts are difficult to search and variable, and tents become unsuitable for mosquitos in the heat of the day, an experimental standardised portable trap hut was introduced in 1945. It was a wooden frame construction measuring $8 \times 4\frac{1}{2} \times 6$ ft., with panels of gauze 1 ft. deep around it $3\frac{1}{2}$ ft. up and vertical slits protected by an overhanging flap of gauze above and below the panels. A weekly catch in one of these traps should be an accumulation of seven nights' entries, but it was found in practice that unless great care was taken with the adjustment of the gauze flaps, the closing of the door and the mending of cracks that appeared in the walls, mosquitos were not trapped.

Jepson (W. F.), Moutia (A.) & Courtois (C.). **The Malaria Problem in Mauritius: the Bionomics of Mauritian Anophelines.**—*Bull. ent. Res.* **38** pt. 1 pp. 177–208, 8 figs., 15 refs. London, 1947.

This account of the results of investigations on the distribution of Anophelines in relation to malaria in Mauritius and the effect of environmental factors on them is preceded by brief notes on the history of the knowledge of Anophelines and malaria in the island since the first epidemic in 1865 and on the organisation for their control set up there in June 1942, keys to the females and mature larvae of the four Mauritian species of *Anopheles* (*A. gambiae*, Giles, *A. funestus*, Giles, *A. coustani*, Lav., and *A. maculipalpis*, Giles [*cf. R.A.E.*, B **33** 114]), and notes on bionomics and morphology designed to facilitate the recognition of the first three species in the field. No evidence was found of the presence of *A. melas*, Theo., in the saline coastal swamps [*cf.* **24** 311]. Anopheline abundance was estimated by spraying huts with a pyrethrum preparation and collecting the mosquitos knocked down on to sheets. Observations in two areas showed that morning catches (6.30–8.30 a.m.) yielded greater numbers of *A. gambiae* and *Culex* than evening ones (6.30–8.30 p.m.), whereas *A. funestus* was more abundant in the evening. Collections of live mosquitos for dissection made after 9 a.m. consisted almost exclusively of *A. funestus*. Where spleen indices were over 75 per cent., *A. funestus* was found in considerable abundance (10–350 adults per room) and natural breeding places were numerous. Where some anti-malaria work had been carried out and in urban areas, *A. funestus* gave place to *A. gambiae*, and malaria transmission was practically confined to the 4–5 months of the hot wet season with corresponding lessening in severity [*cf.* **12** 78 but also **25** 180]. Habitations or barracks that yielded 1–5 Anophelines per hut were regarded as fairly highly malarious. *A. funestus* was found at altitudes up to 900 ft. and in one epidemic area at 1,500 ft. Only rare individuals of *A. gambiae* were found above 1,000 ft. [*cf.* **12** 78].

The influence of a number of environmental factors on Anophelines is discussed, and it is concluded that temperature is an important limiting factor, generally in winter and throughout the year in the highlands (above 1,000 ft.), and that the flushing action of heavy rains and probably the precipitation of the food supply of the larvae by colloidal iron derived from ferrugineous lavas under high rainfall conditions (over 100 ins.) play their part in the natural control of *A. funestus* and *A. gambiae*. There is little significant correlation between rainfall distribution and spleen indices in coastal areas where permanent swamps abound. On the inland plains, low rainfall is correlated with comparatively low malaria rates and a short season of occurrence.

The life-cycle of *A. gambiae* was studied in the field at different seasons as a check on laboratory rearings. It was found that the relation of temperature to duration of development could be expressed on a graph by means of two

catenary curves, for which the formulae are given and between which nearly all the observed values fell. Differences of temperature between 30 and 38°C. [86 and 100·4°F.] modified only slightly the duration of development from egg to adult, which was about 5–10 days at this level, but a decrease of 1°C. [1·8°F.] might add a week or more to the developmental period between 26°C. [78·8°F.], when it took 12–18 days, and 18°C. [64·4°F.], when it took more than 35 days. It is apparent that *A. gambiae* will not complete its life-cycle at the low temperatures normally occurring in winter on the coast and all the year round in the residential uplands above 1,000 ft. The lower limit of activity of larvae of *A. gambiae* was 16·5°C. [61·7°F.]. Larvae of *A. gambiae* all died in two hours at 42°C. [107·6°F.] and those of *A. funestus* in 75 minutes at 40°C. [104°F.]. The normal temperatures of the breeding places of *A. funestus* rarely exceeded 26°C., and the development period was rarely under 21 days. In the laboratory at a mean of 24°C. [75·2°F.], the life-cycle varied from 20 to 31 days with a mean of 24.

In the coastal regions, *A. gambiae* possesses a marked tolerance to highly saline waters and was found commonly at the upper limit of mangrove (*Rhizophora mucronata*), where rainwater and seepages dilute the tidal water. Swamps characterised by *Paspalum vaginatum* were a dangerous source of *A. gambiae*, but *A. funestus* was not found in them. The pH of natural breeding places varied from 7 to 8·6 and appeared to have little influence in affecting distribution in the regions below 1,000 ft. Upland waters were usually neutral or slightly acid and this may be correlated with the absence of *A. funestus* and *A. gambiae*, but it did not affect *A. coustani*. Melanism in larvae of *A. gambiae* was found in nearly all lowland areas but not above 600 ft. It was not related to salinity or pH but may be correlated with high temperatures. So far as is known, all melanic larvae give rise to typical adults of *A. gambiae*. Melanism was never found in all larvae in one breeding place.

Shade alone seemed unlikely to control *A. funestus* in sluggish lowland waters. The apparent effect of shading is almost certainly due to the lowered temperature rather than to critical reductions in light intensity. The flight range of Anophelines in Mauritius does not normally exceed a mile, and in the town of Port Louis, houses within a quarter of a mile of a large seasonal breeding area were quite free of both vector species. A cyclone in January 1945 with a wind velocity of nearly 100 miles an hour caused a complete disappearance of both adults and larvae for 14 days, but the adult population was normal again within 28 days. The average percentage of females of *A. funestus* in which malaria parasites were found was about 3.

TOUMANOFF (C.). **Notions sur les insectes et autres arthropodes d'intérêt médical et vétérinaire.**—233 pp., 75 figs., refs. Saigon, A. Portail, 1942.

This is a popular account, with particular reference to Indo-China, of the appearance, bionomics, medical or veterinary importance and control of the various Arthropods that infest man or domestic animals or transmit diseases to them.

BUXTON (P. A.). **The Louse. An Account of the Lice which infest Man, their medical Importance and Control.**—2nd edn., $8\frac{1}{2} \times 5\frac{1}{2}$ ins., viii+164 pp., 47 figs., $13\frac{1}{2}$ pp. refs. London, E. Arnold & Co., 1947. Price 10*s.* 6*d.*

The first edition of this work [*cf. R.A.E.*, B **27** 252] has been revised in the light of the great increase in knowledge concerning the control of *Pediculus humanus humanus*, L. (*corporis*, Deg.), *P. h. capitis*, Deg., and *Phthirus pubis*, L., that took place between its publication and April 1945 when the text of this

second edition was completed. The chapter on control has been completely re-written, and additional information is included on the sense organs of *Pediculus*, and certain aspects of biology, notably behaviour as observed in a study of sensory physiology.

HUBBARD (C. A.). **Fleas of western North America. Their Relation to the public Health.**—$9\frac{3}{4} \times 6\frac{1}{4}$ ins., ix+533 pp., frontis., 4 pls., 3 figs., text ill., 4 pp. refs. Ames, Iowa, Iowa St. Coll. Press, 1947. Price $6.

The introductory part of this book deals with the contributions made by various workers to knowledge of the fleas of western North America (the parts of Canada, the United States and Mexico west of the 100th meridian), field and laboratory technique for collecting and studying fleas, the anatomy of the flea in relation to taxonomy, and the medical importance of fleas, chiefly in relation to plague and typhus. In this connection, the history of the spread of plague in man in the United States is reviewed and a doubtful case is recorded from Canada, the development of knowledge on the transmission of murine typhus, which is common in man in Mexico and not uncommon in the United States, is discussed, and notes are also given on tularaemia in man and rodents in the United States and Canada.

The second and longest part is a systematic study of the species and subspecies of fleas found in western North America. There are more than 230 belonging to 66 genera. Keys are given to the families of Siphonaptera and to the genera and species occurring in the area dealt with. These genera and species are described, and records are given of the hosts on which the species were taken in various localities, as well as notes on such subjects as seasonal and geographical distribution, biology, importance and control. Figures prepared by the author are given of almost all the species. The States and Provinces from which each species has been recorded are shown in a table, in which the species that are known or thought to be vectors of plague or known to be vectors of murine typhus are also indicated. A similar table is given of the fleas of the eastern United States.

The third part of the monograph is concerned with hosts. A list is given of the 18 genera of rodents in which plague has been found in North America, showing the year and locality of the earliest record. The 32 genera occurring in the western area are then considered, and notes are given on the distribution of each and on the fleas known to infest the various species in different parts of the area. Notes on the susceptibility of various genera or species to infection with tularaemia, plague or murine typhus are included, and also advice on collecting. Further chapters deal with the fleas recorded from Carnivora, Insectivora, bats, man, and birds in different parts of the area.

PAPERS NOTICED BY TITLE ONLY.

SHAW (H.). **The new Insecticides D.D.T. and Benzene Hexachloride and their Significance in Agriculture.** [A review of the literature.]—*J. R. agric. Soc. Engl.* **106** pp. 204–220, 66 refs. London, 1945.

[IL'INSKAYA (M. I.).] ILJINSKAYA (M. I.). **The Mechanism of insecticidal Action and the Permeability of the Cuticle of Insects.**—*C. R. Acad. Sci. URSS* (N.S.) **51** no. 7 pp. 557–559, 5 refs. Moscow, 1946. [See *R.A.E.*, A **35** 277.]

RODHAIN (J.) & VAN HOOF (M. T.). **Recherches sur l'anophélisme en Belgique (deuxième communication).**—*Ann. Soc. belge Méd. trop.* **23** no. 3–4 pp. 209–218, 2 maps, 1 ref. Brussels, 1943. (With a Summary in Flemish.)

In further observations on the varieties of *Anopheles maculipennis*, Mg., in Belgium [*cf. R.A.E.*, B **32** 96], *A. m. atroparvus*, van Thiel, was found again very frequently in the polder region and twice outside it. *A. m. messeae*, Flni., and *A. m. typicus* are recorded from various localities.

SCHWETZ (J.). **Sur quelques foyers cryptiques de *Spirochaeta duttoni* du Congo oriental.**—*Ann. Soc. belge Méd. trop.* **23** no. 3–4 pp. 219–236, 1 fig., 4 refs. Brussels, 1943. (With a Summary in Flemish.)

Ornithodoros moubata, Murr., was discovered in five localities in the eastern Belgian Congo between Lake Kivu and Lake Albert in 1939. No illness resembling relapsing fever had been reported from the infested areas, and the blood of 485 natives was found to be negative for spirochaetes. However, injection of suspensions of the ticks into rats and mice revealed the presence of *Spirochaeta duttoni* in four of the five localities. Similar experiments in 1941 with small numbers of old ticks and of their progeny were all negative, but Rodhain succeeded in infecting a mouse with one of several small batches of nymphs sent to him. It is concluded that four of the localities were undoubtedly foci of relapsing fever, although carriers of spirochaetes were not found among the native population, and that this confirms the fact that immunity is acquired. It also appears that only some of the ticks in a natural focus harbour the spirochaete, that the proportion is not always the same and may be small, and that the proportion among their progeny is probably smaller still.

VAN OYE (E. L.). **Sur le rôle des argasides dans la transmission des maladies infectieuses.**—*Ann. Soc. belge Méd. trop.* **23** no. 3–4 pp. 237–255, 22 refs. Brussels, 1943. (With a Summary in Flemish.)

An account is given of experiments primarily designed to investigate the possibility that *Argas reflexus*, F., which commonly infests pigeons in Belgium, is concerned in the transmission of pigeon salmonellosis [*cf. R.A.E.*, B **33** 143], but extended to include *Ornithodoros moubata*, Murr., and *O. tholozani*, Lab. & Mégn. They were made with 153 individuals of *A. reflexus*, 192 of *O. moubata*, 111 of *O. tholozani* and a strain of *Salmonella* taken from a pigeon. White mice and small birds were the test animals. The only larvae that could be used were *O. tholozani*. They absorbed *Salmonella* when they fed on an infected mouse but did not retain it for a month. All test individuals of *O. moubata* and *O. tholozani*, which were fed on infected mice, and 81 per cent. of *A. reflexus*, which were fed on infected birds, acquired the *Salmonella*. *A. reflexus* tends to leave its host before it is fully engorged, and moreover, the birds were poor in bacilli. The bacilli could be demonstrated in the ticks immediately after the blood-meal and persisted for a long time, retaining their virulence. The longest observed times of survival were 450 days in *A. reflexus*, 462 in *O. moubata* and 325 in *O. tholozani*, all in individuals infected as young nymphs. Probably these ticks would have kept infection throughout life if fed regularly. Bacilli in flattened ticks often died, probably through desiccation.

There was no more mortality among infected than uninfected ticks at ordinary temperature [*cf. loc. cit.*]. In *A. reflexus*, which is resistant to cold, there was no intensive multiplication of bacilli from 0°C. [32°F.] to room temperature, but multiplication increased with rise in temperature above 20°C. [68°F.] and became so intense above 30°C. [86°F.] that the ticks died, usually in 24 hours. *O. tholozani* was also killed in 24 hours above 30°C. *O. moubata*, which is susceptible to cold but resistant to heat, died in less than 24 hours between 0 and 5°C. [41° F.], whether infected or not, but many infected individuals

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maintained at 37°C. [98·6°F.] for a week remained normal provided that they had been subjected to heat before bacilli had developed in the body cavity. The bacilli conserved their virulence in the bodies of dead ticks until these dried up, and caused fatal infection in mice that ate the ticks.

Infection disappeared from 90 per cent. of *O. moubata* and 50 per cent. of *A. reflexus* after a meal on a pigeon with highly agglutinating serum. The importance of the vaccination of pigeons is thus demonstrated. Bacilli were never transmitted to healthy animals by biting when contamination of the wound was prevented. *O. tholozani* does not emit coxal fluid or excreta on its host, but *O. moubata* twice transmitted the infection to mice, presumably by means of the coxal fluid. Three out of ten cultures of coxal fluid were positive, and positive cultures were also twice obtained with guanine (waste matter eliminated through the Malpighian tubes) cultured immediately after elimination by ticks that had had their infective meal 116 and 93 days earlier. Neither coxal fluid nor guanine eliminated during the first meal after the infective one was infective. In *A. reflexus*, the bacilli are eliminated in the faecal matter. Individuals that have engorged on an infected bird might therefore transmit the disease indirectly, but no great importance is attached to this possibility, as *A. reflexus* does not excrete faecal matter for some time after a blood-meal and seeks dry, concealed resting places between meals, so that it would be unlikely to contaminate water. Mice, however, became infected by ingesting an infected tick, and such mice might contaminate pigeons' water and food with their excreta. Eggs deposited by females of *O. moubata* and *A. reflexus* were negative when cultured, as were larvae or nymphs developed from them and subsequently fed on healthy animals.

From these results and those of other workers, it is concluded that the part played by ticks in the transmission of bacterial diseases seems to be comparatively unimportant.

RODHAIN (J.) & VAN HOOF (M. T.). **Au sujet d'un élevage de *Glossina palpalis* en Europe et de quelques essais d'évolution chez cette glossine des *Trypanosoma lewisi* et *cruzi*.**—*Ann. Soc. belge Méd. trop.* **24** no. 1–2 pp. 54–57, 3 refs. Brussels, 1944. (With a Summary in Flemish.)

Mellanby & Mellanby reared four generations of *Glossina palpalis*, R.-D., in London [*R.A.E.*, B **25** 136]. The authors first attempted to rear this species in Antwerp in 1934 but had very little success. A second attempt was made in 1939, starting with pupae received from Leopoldville on 15th August. The adults that emerged were placed in the proportion of three females to one male in glass tubes one-third lined with blotting paper. These tubes were kept at 24°C. [75·2°F.] and a humidity of more than 80 per cent. The flies were given the opportunity of feeding daily on guineapig or rabbit. Six generations were reared before the work was interrupted in 1940, but a large population was never built up.

In four individuals of *G. palpalis* from this culture that were allowed to feed on rats infected with *Trypanosoma lewisi*, no development of the trypanosome took place. A few living forms found in one of the flies were undoubtedly survivors from the meal taken the day before. In the course of three experiments with small numbers of flies fed for several days on a guineapig infected with *T. cruzi*, there was no development of the flagellate in the digestive tract. These results are considered inconclusive in view of the small number of flies used.

VAN DEN BERGHE (L.) & BONÉ (G.). **Cas de myiase intestinale à *Eristalis*.**—*Ann. Soc. belge Méd. trop.* **24** no. 1–2 pp., 69–70, 1 pl., 5 refs. Brussels, 1944. (With a Summary in Flemish.)

A man who had suffered for three weeks from various distressing symptoms including nervousness, fever, hunger, irritation of the nose and loss of weight,

excreted more than 40 larvae of *Eristalis* in one day and 10–30 on each of the six following days. At the end of this time, he was somewhat anaemic. Some of the larvae were young and some fully developed. No more were emitted, and the man recovered completely in a month, the anaemia righting itself without treatment. It is concluded that the larvae were probably responsible for the disorders and anaemia. This is thought to be the first record of intestinal myiasis caused by *Eristalis* in Belgium.

HARVEY (W. C.) & HILL (H.). **Insect Pests.**—2nd edn., 7½×5 ins., xi+347 pp., 2 pls., 24 figs. London, H. K. Lewis & Co., Ltd., 1947. Price 14*s*.

This second edition of a work already noticed on household pests and their control in Britain [*R. A. E.*, B **28** 149] is arranged in the same way as the earlier one. The first part, which deals with the pests individually, occupies 126 pages, and those to which most space is devoted are mosquitos, the bed-bug (*Cimex lectularius*, L.), lice (*Pediculus humanus humanus*, L., *P. h. capitis*, Deg., and *Phthirus pubis*, L.), and fleas, the others including *Musca domestica*, L., cockroaches, and *Sarcoptes scabiei*, Deg. The legislation referred to in the second part includes the Scabies Order of 1941, the information on the control of insects infesting foodstuffs is supplemented by data on the prevention of such infestation, and a whole chapter is added on DDT and benzene hexachloride, the latter being dealt with very briefly.

[NAUMOV (K. G.).] **Наумов (К. Г.). An Experiment in Mass Control of Mosquitos in Daytime Shelters in the Valley of the Chu.** [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 8–13, 12 refs. Alma-Ata, 1944.

The value against malaria of destroying Anophelines in their daytime resting places was tested in the summer of 1938 in seven districts in the valley of the Chu, in northern Kirghizia, where *Anopheles maculipennis* var. *messeae*, Fln., is the chief vector [*cf. R.A.E.*, B **34** 75]. Nearly 128,000 buildings were surveyed, and 30,296, comprising dwellings, animal quarters and uninhabited buildings, were found to harbour Anophelines. The numbers of the latter were greatest in July and August, and showed a sharp decrease in September. Animal quarters were preferred ; dwellings were readily infested, but they were less accessible. Uninhabited premises, such as passages, kitchens and sheds, frequently served as shelters during the summer heat. The numbers of feeding and ovipositing females began to decrease in the second half of August, and examples with a developed fat-body appeared. There was a corresponding decrease in the numbers in houses and animal quarters, and an increase in uninhabited buildings and, in September, cellars. Since the mosquitos in inhabited premises were very scattered, the chief method of control consisted in collecting them by means of test tubes, and this was carried out in 27,542 buildings. Over 600 animal sheds and uninhabited outhouses, in which mosquitos were abundant, were sprayed with a 3 per cent. soap solution [*cf.* **26** 219], and 2,144 cellars were fumigated.

Observations on a representative collective farm, situated in a low-lying area near extensive rice-fields, on which some 66,000 mosquitos had been destroyed by catching and spraying, showed that there was no outbreak of malaria in autumn despite the fact that no measures against the larvae were carried out in July or August, so that the mosquito population increased enormously. There was actually a reduction of over 30 per cent. in the incidence of malaria as compared with 1937, and this was a greater reduction than occurred on a neighbouring farm although the medical treatment applied was the same in both cases.

Since the temperature in the buildings during the malaria season reaches 27–28°C. [80·6–82·4°F.], at which the sporozoites mature in 7–8 days, it is recommended that mosquitos in their daytime shelters should be destroyed every five days.

[Ivanov (I. K.).] **Иванов (И. К.). On the Question of the Effect of the Salinity of Water on the Oviposition and Development of the Larvae of** *Anopheles*. [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 14–19, 8 refs. Alma-Ata, 1944.

In ten laboratory tests, carried out in summer in Kazakstan, batches of females of *Anopheles maculipennis* var. *messeae*, Flni., mostly in the final stages of blood digestion, were liberated in a large glass vessel covered with muslin and containing ten small tumblers, of which nine were filled with salt solutions at concentrations ranging from 0·75 to 4 per cent. sodium chloride and the tenth with plain water. An experiment lasted until all the females of a batch had died. Counts of the numbers of eggs laid in the different tumblers in each experiment and of the total numbers of egg-batches deposited throughout the work showed that fresh water was definitely preferred and that fewer eggs and egg-batches were laid as the salinity of the water increased. Thus, 82 batches of eggs were deposited on fresh water, and 28, 20, 6 and 1 on water containing 1, 2, 3 and 4 per cent. sodium chloride, respectively. Concentrations of 2 per cent. or more sodium chloride killed the eggs in 10–20 minutes [*cf. R.A.E.*, B **28** 8]. These results were confirmed by observations in a large outdoor insectary containing ten vessels filled with water with a salinity of 0–4 per cent., the positions of which were changed daily. During July and August, over 17,000 females were released in the insectary and 2,960 egg batches were obtained. Of these 1,079 were deposited on the fresh water, and only 78–10 in water containing 2–4 per cent. sodium chloride. The number of eggs that hatched also decreased as salinity increased, particularly at concentrations of 2 per cent. or more, and the larvae usually died 2–3 days after hatching.

A survey of a pond, a lake, a flooded meadow and sections of various rivers showed that larvae of *Anopheles* occurred in all waters in which the content of sodium chloride did not exceed 2·5 per cent., and other conditions being equal, their abundance decreased as the salinity rose. It is concluded that concentrations of 1·5-1·75 per cent. sodium chloride are the limits above which the immature stages of *A. m. messeae* do not survive under experimental conditions, whereas this limit is raised to 2·5 per cent. under natural conditions.

[Skopin (N. G.).] **Скопин (Н. Г.). The Geography of the Malaria Mosquitos in Kazakstan.** [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 44–48, 8 refs. Alma-Ata, 1944.

The author states that the six species of *Anopheles* that occur in Kazakstan are *A. maculipennis*, Mg. (represented by vars. *typicus*, *messeae*, Flni., *sacharovi*, Favr, and *atroparvus*, van Thiel), which is the commonest, *A. claviger*, Mg. (*bifurcatus*, auct.), *A. hyrcanus*, Pall., *A. pulcherrimus*, Theo., *A. superpictus*, Grassi, and *A. algeriensis*, Theo., and discusses their local distribution. A single example of *A. plumbeus*, Steph., was taken in Kazakstan in 1937, but this species has not been found there since.

[Galuzo (I. G.).] **Галузо (И. Г.). Ecological Bases of the Control of the Vectors of Theileriasis of Cattle.** [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR.* (Ser. zool.) no. 3 pp. 92–109, 40 refs. Alma-Ata, 1944.

As the piroplasmosis of cattle caused by *Theileria annulata* is widespread in parts of southern Kazakstan, investigations were made on the bionomics, ecology and control of its two local tick vectors, *Hyalomma detritum*, Schulze,

and *H. anatolicum*, Koch, of which *H. savignyi*, Gerv., is treated as a synonym. Collections of ticks from farm animals in 1938 and 1939 showed that cattle were the chief hosts of the larvae, nymphs and adults; both species were also found on horses and *H. anatolicum* on sheep. Neither was found on wild birds, rodents or reptiles, or in their nests, burrows or shelters. Unfed adults and engorged larvae and nymphs of *H. anatolicum* occurred in cracks in the clay walls and wooden parts of cattle sheds, in cobwebs in corners in them, and in cracks in the walls of an inhabited house, but *H. detritum* was not found in such places.

The counts made from farm animals were used to provide data on the bionomics of the ticks, and it was apparent that neither had more than one generation a year. *H. anatolicum*, which the author considers as primarily a three-host tick [*cf. R.A.E.*, B **35** 73, 75], hibernated off the host in the stages of egg, engorged nymph and unfed adult. The cattle were infested in March and April by the overwintered adults, from May to September by adults from the overwintered nymphs, in May, June and July by larvae from the overwintered eggs, and in the second half of summer by larvae from eggs laid in May and June. All the larvae moulted to nymphs that engorged on cattle in late summer or autumn. Nymphs that dropped from their hosts in July gave rise to adults in September, but those that did so later overwintered together with the young unfed adults. The duration of the individual stages depended on temperature; cold weather retarded the hatching of the eggs and the moulting of the nymphs, and reduced the number of females that were able to oviposit.

H. detritum, which is a two-host tick, hibernated on the cattle in the stage of unfed nymphs. These engorged and dropped from their hosts between the end of February and the end of April, and gave rise to adults in May–August, after periods varying with the microclimate of the pasture. The cattle were infested by adults from about mid-May until the end of August, the peak of infestation being reached in June, but were completely free from this tick in September. The adults oviposited under grass, and the resultant larvae sheltered in cracks in the soil until October or November, when they ascended grasses and attacked grazing cattle, on which they engorged and moulted into nymphs. A few of the nymphs engorged and dropped off before winter set in, but the majority overwintered on the hosts before feeding.

The effect of the microclimate of their habitats on the life-cycles of *H. detritum* and *H. anatolicum* is discussed, and it is shown that the development and survival of the individual stages depends on the type of biotope they happen to find when they drop from the host [*cf.* **35** 113]. Infestation can be reduced or prevented by agricultural measures that render the habitats of the ticks unfavourable and interrupt their cycle of development. To destroy the eggs of *H. detritum* and the eggs and larvae of *H. anatolicum*, pastures should be ploughed or disked in May–July, or else mown and the hay and undergrowth removed, so as to expose the soil to the heat of the sun. This can be repeated in September or October against larvae of *H. detritum* sheltering in cracks in the soil, or the grass can be scorched at the end of October or in November, when the larvae ascend it. Nymphs of *H. detritum* can be controlled by ploughing pastures in April or May, and those of *H. anatolicum* by disking or harrowing in autumn. Since larvae of *H. detritum* attach themselves to cattle and horses between October and the end of January, the animals should be kept in during this period or allowed to graze only in pastures with fairly sparse vegetation. To free the animals from nymphs, they should be treated with chemicals at the end of October and again in January. As the nymphs drop from their hosts in February, March and April, pastures that have been grazed during these months should not be used from June to the end of August, so that the resulting adults starve. In the case of *H. anatolicum*, pastures that have been grazed from July to November, and have thus become infested with hibernating eggs and nymphs,

should not be used until July of the following year. It is advisable to pasture the animals on hills and steppes during the first half of the summer and in the lowlands during the second half, since the latter will be flooded in autumn and spring and the eggs and nymphs drowned. Infested animals' quarters and the clay walls of cattle enclosures should be treated with chemicals to destroy any ticks sheltering in them [*cf.* **35** 74].

Instances are given of the successful application of these measures on various collective farms. Materials that proved effective against *H. detritum* overwintering on the animals were a kerosene-oil emulsion, one application of which in winter killed all the larvae and unfed nymphs, and desinsectalin [*cf.* **34** 119], four applications of which (in October, November, January and early March) considerably reduced the infestation of cattle, horses and sheep.

[Skopin (N. G.).] **Скопин (Н. Г.). On the Distribution and Ecology of *Ornithodorus papillipes* Bir. in southern Kazakstan.** [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 110–115, 9 refs. Alma-Ata, 1944.

A survey in southern Kazakstan by L. A. Andreev in 1940 indicated that *Ornithodoros tholozani*, Lab. & Mégn. (*papillipes*, Bir.) was confined to the region of Bostanduik, and this was confirmed in further investigations by the author and others between mid-June and mid-August 1941. Within this region, it was restricted to the valley of the river Chirchik and its tributaries and was present in 17 of the 18 villages examined. The village from which it was absent was situated high in the mountains beyond the juniper zone. In the others, the percentage of infested houses ranged from 5·2 to 72·2 and increased with the dryness of the locality. The ticks were scarce in low-lying damp sites and in villages situated on the banks of rivers or irrigation canals. Within the villages, they occurred, in order of decreasing frequency, in closed cattle sheds, inhabited rooms in native houses, open cattle sheds, hen-houses, store-rooms and other uninhabited quarters, roofed clay verandahs, a living-room of the European type, and the outer side of house walls. Except in closed cattle sheds, they were found chiefly in dust near the burrows of rats and mice, which indicated that the burrows were their main breeding places [*cf. R.A.E.*, B **33** 18]. Examination of the dust showed that it consisted chiefly of fine particles with a humidity of 2·88–6·42 per cent. Larvae and young nymphs tolerated a higher humidity than the adults [*cf.* **17** 106]. A light-coloured substratum was preferred to a dark one containing humus, and no ticks occurred in dust with a considerable admixture of large organic particles, or in dust layers that were less than 0·5 cm. thick.

It is suggested that the tick could be controlled by destroying rodents in houses, stopping up their burrows, pouring boiling water on to the dust near the entrance holes, removing dust from the corners and skirting-boards of rooms, and damping the floors of living rooms and verandahs in summer.

[Shakirzyanova (M. S.).] **Шакирзянова (М. С.). Materials on the Fauna of the Sandflies of Kazakstan.** [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 116–118. Alma-Ata, 1944.

Notes are given on the distribution in southern Kazakstan of ten species of *Phlebotomus* collected there by various workers in August–September 1940 and by the author in 1941. They comprised, in order of decreasing abundance, *P. chinensis*, Newst., *P. papatasii*, Scop., *P. caucasicus*, Marz., *P. sergenti*, Parr., *P. grekovi*, Khodukin, *P. alexandri*, Sinton, *P. major*, Annan., *P. sogdianus*,

Parr., *P. sumbaricus*, Perfil'ev, and *P. dentatus*, Sinton (*minutus* var. *arpaklensis*, Perfil'ev). The last five have not previously been recorded from Kazakstan.

[Petrova (E. F.).] **Петрова (Е. Ф.). On the Question of the Method of applying Arsenic for the Control of Flies.** [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 119-122, 1 ref. Alma-Ata, 1944.

An account is given of investigations in Kazakstan in which a solution of 5 per cent. sugar and 1–2·5 per cent. sodium arsenite, referred to as Miofanin, gave good mortality of flies when applied to glass plates under experimental conditions in the laboratory and at a rate of about 0·03 fl. oz. per sq. yard to the inner sides of window panes in buildings of various sorts. The dried films remained effective for several days. Lower concentrations of sodium arsenite were of no value.

[Galuzo (I. G.), Balditzina [Bolditzina] (K. S.) & Kaĭtmazova (E. I.).] **Галузо (И. Г.), Балдицина [Болдицина] (К. С.) и Кайтмазова (Е. И.). Ixodid Ticks—the possible Vectors of Brucellosis.** [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 123–137. Alma-Ata, 1944.

In earlier investigations on the circulation in nature of the causal agent of brucellosis in man and farm animals, *Brucella* was isolated from a naturally infected roe deer, and ground-squirrels [*Citellus*], rats and mice were found to be easily infected in the laboratory. P. F. Samsonov succeeded in obtaining transmission with ticks of the genera *Boophilus*, *Rhipicephalus* and *Ornithodoros*. Further tests were, therefore, carried out by the authors in southern Kazakstan with *Dermacentor marginatus*, Sulz., *Haemaphysalis cinnabarina punctata*, C. & F., and two species of *Hyalomma* [*cf. R.A.E.*, B **35** 112].

In preliminary tests, no infection was detected in adults of *Dermacentor* taken from infected cows or in adults of *Haemaphysalis* and *Dermacentor* allowed to feed on infected sheep or taken in an unfed condition from infected sheep or pastures.

In one instance, however, a guineapig gave a positive Wright reaction 35 days after unfed adults of *Dermacentor* taken in a sheep pasture had been placed on it, and a culture of *Brucella* was obtained from its organs. Larvae derived from females that had engorged on this guineapig were placed on six others, of which one later reacted positively, though no culture was isolated, and another died in a month, its organs showing characteristic pathological changes, though culture was again unsuccessful. The feeding of the resultant nymphs and adults produced no infection in guineapigs. In another instance, larvae derived from engorged females of *Haemaphysalis*, taken in an enclosure containing infected sheep, were placed on two guineapigs, one of which reacted positively 22 days later and at intervals until its death after 57 days. The resulting nymphs were placed on three guineapigs, and one of these gave a positive reaction 25 days later.

In further tests, adults of *Dermacentor* and *Hyalomma* were allowed to engorge on guineapigs artificially infected with *Brucella melitensis*; the organism was later cultured from the body contents of the ticks, and a suspension of their organs, injected subcutaneously into healthy guineapigs, produced infection in some of these in 1–2 months. In the case of the two species of *Hyalomma*, infection was transmitted hereditarily from adult to adult.

It is concluded that *B. abortus* in cows is inaccessible to the ticks owing to its position in the body of the animals, and cannot, therefore, be acquired by them, but that *B. melitensis* can be ingested by ticks that feed on infected sheep and transmitted to other animals through the bite of the subsequent stages.

[Ivanov (I. K.).] **Иванов (И. К.). The Types of Water in which Anophelines breed and the Fauna of Culicidae in the Turgaĭ Depression.** [*In Russian.*] —*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 pp. 128–129. Alma-Ata, 1944.

A survey was carried out in the summer of 1940 of the breeding places of *Anopheles* in the region of Kazakstan comprising the populated valleys of the Irgiz and Turgaĭ. It has a continental climate. In spring, the rivers flood areas 2–2½ miles wide, which gradually become overgrown with vegetation and provide favourable breeding places for Anophelines. Towards mid-summer, the smaller rivers dry up almost completely, and the large ones are reduced to a series of streams, stagnant pools and lakes, in all of which dense vegetation develops and larvae of *Anopheles* abound. At the same time, some larvae develop in irrigation ditches, ponds and borrow pits.

The only Anopheline found was *A. maculipennis* var. *messeae*, Flni., though *A. hyrcanus*, Pall., had been recorded in this area by Geller [*R.A.E.*, B **28** 183]. Many breeding places contained third-instar larvae on 24th May, which indicated that the overwintered females had become active in the second half of April. The first males appeared in daytime shelters in the first half of June, and Anophelines were abundant in houses in the second half of June and particularly in July. Females with a developed fat-body appeared in the second half of August. The other mosquitos observed comprised *Culex modestus*, Fic., and three species of *Aëdes*. *A. subdiversus*, Martini, was very numerous and troublesome to man and farm animals.

[Galuzo (I. G.).] **Галузо (И. Г.). Ecological Foundations of Control Measures against Transmitters of Haemosporidiasis of Horses—the Ticks** *Dermacentor marginatus*. [*In Russian.*]—*Izv. kazakhsk. Fil. Akad. Nauk SSSR* (Ser. zool.) no. 3 p. 132. Alma-Ata, 1944.

On the basis of observations in 1940 and 1941 on the bionomics and ecology of *Dermacentor marginatus*, Sulz., in Kazakstan, the author recommends measures for the control of this tick and the protection of horses from infestation. They comprise agricultural measures designed to destroy the eggs, engorged larvae and nymphs on pastures, such as mowing and the subsequent removal of the hay, ploughing strips of soil along roads and fields, destroying dense growths of weeds near irrigation ditches, and sowing fodder grasses in pastures; cleanliness in stables and yards, to prevent the ticks from developing in straw and dung; the destruction of small rodents, which serve as hosts for the ticks and carry them from place to place; and protecting horses from infestation in the field by keeping them away from the margins of roads or fields and other places covered with shrubby vegetation, where the ticks concentrate. These measures should be supplemented by chemical treatment of infested animals.

Newton (W. L.) & Pratt (I.). **Experiments to determine whether infective Larvae of *Wuchereria bancrofti* can migrate from the Abdomen of the Mosquito intermediate Host.**—*J. Parasit.* **31** no. 4 pp. 266–268, 2 refs. Lancaster, Pa., 1945.

The following is mainly taken from the authors' summary and conclusions. Infective larvae of *Filaria* (*Wuchereria*) *bancrofti* were implanted in the abdomens of previously uninfected mosquitos to determine whether they could migrate to other parts of the body, particularly the proboscis. Of 27 mosquitos so inoculated and still containing at least one living larva when dissected 20–105 minutes later, 22 contained larvae that had left the abdomen. Of 68 active larvae recovered, 32 were in the thorax and 12 had reached the head or proboscis. It is concluded that there is a definite tendency to migration away

from the abdomen and that infective larvae in any part of the body of the mosquito are potentially capable of infecting man. The time required for migration to any particular part of the body was very variable.

Owen (W. B.). **A new Anopheline from the Solomon Islands with Notes on its Biology.**—*J. Parasit.* **31** no. 4 pp. 236–240, 2 figs. Lancaster, Pa., 1945.

The larva and adults of both sexes of *Anopheles koliensis*, sp. n., from the north coast of Guadalcanal, British Solomon Islands Protectorate, are described, and characters are given for separating them from those of *A. punctulatus*, Dön., and *A. farauti*, Lav., to which it is closely allied. A study, in both wild and reared specimens, of the degree of variation in the costal markings of the wing and the light patch of scales on the ventral side of the labium of the female, which are the chief distinguishing characters for adults, led to the conclusion that they are stable and that *A. koliensis* is a true species and not a hybrid of *punctulatus* and *farauti*. It may prove to be identical with a member of the *punctulatus* group that is not known to occur east of New Guinea and is usually classified as *A. moluccensis*, Sw. & Sw., despite the fact that it has a pale ventral area on the labium [*cf. R.A.E.*, B **33** 79].

The larvae were collected from temporary pools in grassland and pools along the edge of the jungle in association with *A. farauti* and once with *A. punctulatus* also. The adults are strongly attracted by man and were found resting during the day in native huts in greater numbers than any other local Anophelines. Of 500 females from tents occupied by a native labour group, 450 were *A. koliensis*, 29 *A. farauti* and 21 *A. punctulatus*, whereas only 10 per cent. of the larvae of these Anophelines found in the same area at the same period were *A. koliensis*. The females were active from about 9 p.m. until daylight and most active after midnight. Adults were frequently reared from eggs laid by gravid females taken in native dwellings. The average time required for development from egg to adult was 11 days. Females thus reared fed readily on man.

Belkin (J. N.), Knight (K. L.) & Rozeboom (L. E.). **Anopheline Mosquitoes of the Solomon Islands and New Hebrides.**—*J. Parasit.* **31** no. 4 pp. 241–265, 27 figs., 9 refs. Lancaster, Pa., 1945.

On the basis of material collected or reared during extensive work, chiefly on Espiritu Santo in the New Hebrides and on Guadalcanal in the lower Solomon Islands, descriptions are given of the adults of both sexes, pupae and fourth-instar larvae of the Anophelines that occur on the two groups of islands (*Bironella hollandi*, Taylor, *Anopheles solomonis*, sp. n., *A. lungae*, Belkin & Schlosser, *A. punctulatus*, Dön., *A. farauti*, Lav., and *A. koliensis*, Owen, in the Solomon Islands and *A. farauti* in the New Hebrides), together with keys to them and a description of the egg of *B. hollandi*, the species tentatively identified as *B. walchi*, Soesilo, by Belkin & Schlosser [*R.A.E.*, B **33** 79]. Notes are also given on their distribution [*cf.* **34** 122; **35** 12], bionomics and taxonomy.

The five species of *Anopheles* all belong to the *Neomyzomyia* group of the subgenus *Myzomyia*, but *A. solomonis* and *A. lungae* form a distinct complex and should perhaps be recognised as a separate series. Characters are given distinguishing them from each other and from other Oriental and Australasian members of the group, both in the larval and adult stages. The pleural hairs of the larvae show branching, which is inconsistent with the definition of the group but is found in three other forms usually referred to it. The larvae of *A. solomonis*, which were scarce, were collected most often in small streams 1–4 miles into the coral foothills of the north-western coast of Guadalcanal at elevations of 1,500 ft. They were found in pot holes in coral stream beds, in coral depressions above the beds, along the margins of the streams and in their blocked mouths. One collection was made in a shallow taro swamp. The

water was sometimes clear and running, sometimes stagnant with a high organic content. The larvae were nearly always taken in deeply shaded areas among floating sticks or leaves along the margins of pools. Larvae of this species and of *A. lungae* crawl on leaves and banks out of the water, and the pupae of both species also work their way out of the water. *A. solomonis* may be collected throughout the year, but more easily during the dry months. All eggs do not hatch at once ; the larval stage lasts 10–14 days and the pupal stage 2–3 days. Adults of both sexes were found in very small numbers resting in the daytime with those of *A. lungae* on the trunks of large trees in swampy jungle areas. Breeding places of *A. lungae* other than those noticed by Belkin & Schlosser [**33** 79] included coastal lagoons, pig wallows and artificial containers. The water sometimes had a very high organic content, but was usually clear and cool. Adults generally emerged from pupae resting above the surface of the water. Numbers were greatest in the rainy season. An ability shown by the eggs to withstand considerable drying is probably an adaptation to breeding places that are periodically flushed. Some eggs hatched in 3–4 days and some not for two weeks or longer. The larval and pupal stages lasted about 10 and 2–3 days, respectively. Adults usually rested within a foot of the ground where humidity was high and light poor. They became active about 6.30 p.m. in the rainy season, and all had left their resting places an hour later. They returned between 6 and 6.30 a.m. and showed very little activity in the daytime. Examination of blood from females collected on tree trunks within half a mile of dwellings showed that about 70 per cent. of the blood-meals were non-mammalian.

A. punctulatus, *A. farauti*, *A. koliensis* and *A. moluccensis*, Sw. & Sw., form a closely related complex. The larvae of *A. moluccensis* from New Guinea appear to be similar in structure to those of *A. farauti*, in that the tubercles of the prothoracic submedian hairs are fused and hair 1 of abdominal segment I is distinctly palmate with flattened leaflets. However, according to Swellengrebel and Rodenwaldt [**20** 120], the adults of this species have the small light ventral patch of the labium characteristic of *A. koliensis* [*cf.* **33** 79 ; **35** 161]. Larvae of *A. koliensis* and *A. moluccensis* are easily separated from one another. Until comparison can be made with the type of *A. moluccensis* and with reared material from New Guinea, the exact relationship of *moluccensis* to the other two forms cannot be determined. Although no conclusive cross-breeding experiments have been made, the fact that the progeny of all species except of one female of *koliensis* bred true indicates that hybridisation between the three members of the *punctulatus* series in the area in question does not normally occur in nature, even though they exist side by side. They can be separated from one another in the adult, pupal and larval stages, and the authors prefer therefore to treat them as species.

On Guadalcanal, *A. punctulatus* is restricted to the valleys of the larger streams and rivers, usually occurring near native villages and away from the coast. The larvae, which are very active, were collected most frequently in sunlit ruts and other temporary pools, which may be muddy and free of vegetation and floatage or have marginal vegetation and dense algal growth. They were sometimes found in partial shade. This Anopheline almost disappears during dry weather, when its chief breeding places are greatly reduced, and it resorts to breeding in streams. During the rains, it extends its range into the coastal plain, where it breeds in the same waters as *A. farauti*. In early March 1944, with water temperatures of 70–91°F., high rainfall and unfavourable food supply, the egg, larval and pupal stages of both forms lasted slightly less than two days, five days and about 20 hours, respectively. The finding of first-instar larvae in isolated temporary pools less than a day after these had become filled with water indicates that eggs may be laid in mud. Fourth-instar larvae and pupae appeared when water refilled puddles that had dried completely two days earlier when containing larvae and pupae. In a colony of *A.*

punctulatus maintained for three months during the dry season, gravid females would not lay eggs in small water containers but scattered them on the floor of the cages. Females fed readily in captivity, but they do not appear to attack man often in nature on Guadalcanal. Less than 1 per cent. of the Anophelines collected in routine night catches in a year were of this species.

Larvae of *A. farauti* from parts of Guadalcanal where there is little chance of human contact differ somewhat from those reared in the laboratory, and adults reared from them do not feed readily on man. The natural breeding places of *A. farauti* are varied [**34** 122], but they never included undisturbed canebrake marsh or large open sunlit swamps in the jungle filled with floating and emergent vegetation, and are normally never far from settled areas. Breeding persists in once occupied areas later abandoned. Artificial containers are used to a limited extent, but not water collected in plants or water with a high organic content. Breeding in extensive expanses of water is usually associated with floatage and emergent or surface vegetation. Females enter any type of shelter in search of human blood and feed readily out of doors. Throughout the area covered by this report, except for isolated parts of Koli district, Guadalcanal, *A. farauti* is the principal species of *Anopheles* attacking man. It comprised 98 per cent. of the Anophelines in the routine night catches on the north-western coast of Guadalcanal. Adults have been taken at least a mile from the nearest known breeding area. Females were kept alive in a small cage for about 35 days. Males survived less than two weeks. Both insectary and cage matings were obtained.

Belkin (J. N.). *Anopheles nataliae*, **a new Species from Guadalcanal.**—*J. Parasit.* **31** no. 5 pp. 315–318, 6 figs., 2 refs. Lancaster, Pa., 1945.

Descriptions are given of the larva, pupa and adults of both sexes of *Anopheles* (*Myzomyia*) *nataliae*, sp. n., a third member of the *lungae* series of the *Neomyzomyia* group [*cf. R.A.E.*, B **35** 161]. Larvae and pupae were taken in seepage and spring areas with clear, running, densely shaded water in two places more than a mile apart in the coral foothills of north-western Guadalcanal. They rested on floating vegetation and débris or on the margins of creeks, usually where the current was fairly swift. The larvae were extremely active. In the laboratory, pupae usually rested above the water surface, and the adults emerged from them in this position. Adults were not taken in nature.

Addis (C. J.). **Laboratory Rearing and Life Cycle of** *Phlebotomus* (*Dampfomyia*) *anthophorus* **Addis (Diptera : Psychodidae).**—*J. Parasit.* **31** no. 5 pp. 319–322, 5 figs., 7 refs. Lancaster, Pa., 1945.

In attempts in Texas to rear *Phlebotomus anthophorus*, Addis [*R.A.E.*, B **35** 139], adults died in the apparatus described by Nájera [**29** 187], because moisture condensed on the sides of the vials. This was remedied to some extent by cutting off the upper ends of the vials and covering them with muslin, but the apparatus was still unsuitable for large-scale work. A breeding chamber was therefore constructed by filling an earthenware dish two-thirds full with plaster of Paris and fixing a lantern globe, the upper end of which was covered with muslin, on the surface with a ring of paraffin wax. The whole was placed in a tray of water and kept at 28°C. [82·4°F.]. Adults caught in nature were confined in vials plugged with cotton wool moistened with sugar water and released on arrival at the laboratory at night into a feeding cage containing a hamster. Few fed during the night, but most did so between 9 a.m. and noon [*cf.* **35** 139]. The engorged females were placed in the breeding chambers, the eggs they laid were counted, and food for the larvae was then spread on the plaster of Paris. A mixture of dried rabbit faeces and blood did not enable the larvae to pupate in two months, but when a few drops of fluid containing all the

known components of the vitamin B complex were added, pupation occurred within three days. A mixture of rich garden earth and rabbit blood was later found to give satisfactory results without the addition of vitamins and was finally used exclusively. Emerging adults were immediately put in another chamber with a piece of cotton-wool soaked in sugar water and transferred to feeding cages after 2–3 days and then to the breeding chambers. With this technique, engorged females from six groups of 12 sandflies oviposited 3–6 days after the blood-meal (a single female laying as many as 20 eggs in clusters of 5–6 or singly), the egg, larval and pupal stages lasted 9–14, 22–38 and 8–10 days, respectively, and females took a blood-meal 2–4 days after emergence and survived a further 4–9 days when fed on raisins. One sandfly took a second blood-meal on the eighth day. The eggs are very briefly described, and the immature stages are figured.

The technique could probably be adapted for rearing other species of *Phlebotomus*, but larvae of *P. diabolicus*, Hall, though they developed fully, failed to pupate even when the vitamins of the B complex were added to the food.

GRIFFITHS jr. (J. T.). **A Scrub Typhus (Tsutsugamushi) Outbreak in Dutch New Guinea.**—*J. Parasit.* **31** no. 5 pp. 341–350, 5 figs., 3 refs. Lancaster, Pa., 1945.

An outbreak of tsutsugamushi disease with 931 cases and 34 deaths occurred among United States troops during August and September 1944 at an advanced base on the coast of Netherlands New Guinea. It began a week after the troops landed, reached epidemic proportions almost immediately and declined after two weeks. Four types of environment were readily distinguishable in the area, namely abandoned native villages and gardens, overgrown coconut groves, beach and forest margins, and climax rain forest [*cf. R.A.E.*, B **34** 146]. Over 500 cases of the disease were contracted in the abandoned clearings, throughout which grass had become established, and this environment also produced the highest incidence in relation to degree of exposure. Incidence was low on two islands covered with overgrown coconut groves, possibly because lack of grass led to a small population of Trombiculids. The strip of grassland and trailing plants that extended along the beach between the sand and the forest accounted for 90 cases. The ground in the climax rain forest that covered most of the base was free of grass and covered only with rotting leaves, and though Trombiculids caused scrub itch in the forest, there was no evidence that it was a source of tsutsugamushi disease. The removal of all grass and undergrowth was found to be a practical means of dealing with an infected area, which apparently became safe as soon as the top soil had dried. As wild rats are known to be the reservoir of tsutsugamushi disease in New Guinea, rat control was begun early in the epidemic but showed no evidence of having any beneficial effect ; it is unlikely to be of value except as a long-term measure, as uninhabited areas adjacent to those to be protected have a large rat population. The impregnation of clothing with an emulsion of dimethyl phthalate and soap [**34** 147] was therefore used, and its effectiveness was demonstrated by several units. An account of these instances is given. The medical characteristics of the disease as observed in a study of 275 cases are described by R. W. Hollenhorst. The incubation period was 7–17 days with an average of 11 days.

ISLAS S. (F.). **Observaciones sobre el tlalzahuate en Izúcar de Matamoros y Acatlán, Puebla (Acarina-Trombidiidae).** [Observations on Harvest Mites in Izúcar de Matamoros and Acatlán, Puebla.]—*An. Inst. Biol. Méx.* **14** no. 2 pp. 439–450, 3 figs., 29 refs. Mexico, D.F., 1943.

In the course of field studies near the town of Izúcar de Matamoros, in the south of the State of Puebla, Mexico, workers were heavily attacked by

Trombiculid larvae. Investigations on these mites, which were also found in the region of Acatlán, were begun in 1942 and they were identified as *Eutrombicula alfreddugèsi*, Oudm., and *Acariscus* (*Trombicula*) *flui*, van Thiel, of which the former was by far the more numerous. *A. flui* had not previously been recorded from Mexico. Characters are given distinguishing the two species. The mites reached maximum abundance during the rainy season, from June to August, but were also observed in December, January and March. They could not be found on rabbits, reptiles, bats or birds, but were very common on ground squirrels (*Citellus variegatus rupestris*). They were principally present on the chalky river banks, where the ground squirrels had their nests, and in damp meadows, where they were found in great numbers on cattle dung. They were most active during the late morning, remaining hidden during the extremes of heat and cold. It was observed that they ran up the warm butt of a rifle as soon as it was grounded, and collections were therefore made by removing them with a toothbrush dipped in fixing fluid from the stock of the author's rifle. The processes used in fixing and mounting specimens are described.

The mites attacked man in places where the skin was tender, giving rise to a rash and irritation that lasted up to four days after they had fallen off. Considerable differences were noticed in the reaction of individuals exposed to the same degree of attack. The local peasants were not often affected, since their skin is coarse and greasy ; small children, however, were heavily attacked. Mites kept under observation usually remained attached to the host for about 48 hours. Preventive and palliative measures are discussed, mostly from the literature [*cf. R.A.E.*, B **28** 247 ; **34** 44], and it is considered that the destruction of ground squirrels is the most likely method to afford control.

Vazquez (L.) & Nieto Roaro (D.). **Observaciones palúdicas en el distrito de Acatlán, Pue.** [Observations on Malaria in the District of Acatlán, Puebla.]—*An. Inst. Biol. Méx.* **14** no. 2 pp. 451–454, 3 figs., 1 ref. Mexico, D.F., 1943.

Observations on malaria in the district of Acatlán, in the south of Puebla, Mexico, carried out in August 1943, during the dry season, showed that the disease was rather more prevalent than in the neighbouring district of Matamoros [*R.A.E.*, B **34** 153]. Larvae of *Anopheles pseudopunctipennis*, Theo., the only Anopheline, were found in all stages of development in irrigation ditches close to the town, although there was no aquatic vegetation present and the water was dirty and stagnant. Adults were taken in dwelling-houses near the breeding places.

Shanahan (G. J.). **D.D.T. and "666" as Larvicides. Experiment with the primary Sheep Blowfly** (*Lucilia cuprina*).—*Agric. Gaz. N.S.W.* **57** pt. 7 p. 382. Sydney, 1946.

Crystalline DDT (95 per cent. p, p′ isomer) and benzene hexachloride (13 per cent. γ isomer) were thoroughly mixed with 25 gm. samples of finely chopped liver to give concentrations of 0·5 and 0·1 per cent. by weight DDT or 0·1 per cent. benzene hexachloride, respectively, 20 partly fed third-instar larvae of *Lucilia cuprina*, Wied., were placed in cavities in the liver, and the whole was put in a jar with a lid with a wire gauze centre. The jars were kept at 75°F. with high humidity for the first 24 hours and at room temperature for the next 24. The larvae were then taken out and placed in an incubator. Each treatment was tested in triplicate, and the experiment was made twice. In the two experiments, the percentages of larvae dead in 48 hours and (in brackets) the percentages that failed to complete development were 82 (90) and 86 (92) for 0·5 per cent. DDT, 70 (86) and 66 (90) for 0·1 per cent. DDT, and 75 (88) and 75 (95) for 0·1 per cent. benzene hexachloride. As DDT appears to have no contact

action on larvae of *L. cuprina* [*R.A.E.*, B **35** 72], its observed toxicity is attributed to action as a stomach poison.

SHANAHAN (G. J.). **The Toxicity of " 666 " to Prepupae of** *Lucilia cuprina*.—*J. Aust. Inst. agric. Sci.* **12** no. 4 pp. 148–149, 3 refs. Sydney, 1946.

Three experiments are described in each of which prepupae of *Lucilia cuprina*, Wied., were kept (at 75°F. and high humidity) in contact with untreated wool or wool steeped at least ten days earlier in xylene emulsions containing 0·5 or 0·1 per cent. 666 (benzene hexachloride containing 13 per cent. γ isomer) prepared by adding one part of a stock solution with emulsifier to 140 and 700 parts water, respectively, or in an emulsion of one part emulsified xylene in 140 parts water. Each treatment was tested three times in each experiment. The total numbers of prepupae that pupated and (in brackets) died without pupating were 4 (214) and 81 (128) in wool treated with 0·5 and 0·1 per cent. 666, respectively, 176 (45) in wool treated with xylene emulsion alone, and 167 (48) in untreated wool. Prepupae exposed to the stronger concentration of 666 were incapable of rapid locomotory movements within 48 hours, and most died in 3–8 days. The effect of the weaker concentration was slower. Prepupae are known to be more resistant to contact insecticides than young larvae. As tests indicated that 666 did not act as a fumigant in these experiments and as prepupae do not feed, it is assumed that the benzene hexachloride acted as a contact poison. The results suggest that it may be suitable for jetting the breeches of ewes and applying to rams' heads for the prevention of fly strike, and may also become an important constituent of blowfly dressings. In limited field trials, samples of wool from the crutch area of ewes jetted five weeks previously with 0·5 per cent. 666 in xylene emulsion were toxic to prepupae.

WATERHOUSE (D. F.) & FULLER (M. E.). **The Use of Borax for the Prevention of Fly Breeding in Trap Baits.**—*J. Coun. sci. industr. Res. Aust.* **19** no. 4 pp. 321–329, 11 refs. Melbourne, 1946.

The blowfly trap designed in Western Australia (W.A. trap) [*R.A.E.*, B **15** 11] allows the flies to deposit eggs or larvae on the bait and the resulting prepupae to escape through the entrance slits. No simple and efficient means of preventing oviposition or escape has yet been devised. An account is given of experiments made with both small experimental glass traps and W.A. traps, in which it was shown that the number of prepupae escaping from the traps is large and may often exceed the number of flies caught [*cf.* **27** 196], though many larvae were destroyed by desiccation, competition and the action of parasites and predators, and some were drowned by rain. The flies bred were generally species of *Calliphora* and sometimes *Chrysomyia rufifacies*, Macq. They never included *Lucilia cuprina*, Wied.

In experiments to determine whether treatment of the bait could prevent breeding without lowering attractiveness, borax sprinkled at 2–10 per cent. by weight killed most of the larvae during their development and all before they pupated [**31** 31], whether water was added or the bait was left to dry, but it reduced the total number of flies caught in W.A. traps by about half. The reduction was rather greater in dry than in wet baits, which were the more attractive, particularly under dry conditions. The addition of 2½ per cent. sodium sulphide [*cf.* **22** 252; **26** 83] enhanced the attractiveness of treated and untreated baits, but the improvement was greater in the bait without borax. It did not prevent larvae developing, but it reduced the number escaping, probably because of the more intense competition for food due to increased attractiveness. Although borax slows down bacterial decomposition, the actual numbers of primary blowflies (including *L. cuprina*) caught by treated baits were generally less than those taken in untreated baits. As adults

of *L. cuprina*, which is responsible for much more infestation of sheep than any other primary fly, were never bred, it is concluded that there is no advantage in adding borax to the bait so far as this species is concerned. *Calliphora stygia*, F., *C. augur*, F., and *Chrysomyia rufifacies* are of some importance as sheep blowflies and are also the main causes of domestic annoyance. Most of the adults of *C. rufifacies* bred are trapped on emergence as the larvae generally pupate in the bait pan. The greater catches given by unpoisoned baits are likely to be offset in the next generation of *Calliphora* spp. by production of adults from larvae that escape, and if trapping is intensive and on a large scale, the immediate decrease effected in population will cause an increase in the next generation owing to reduced competition for food [**22** 261]. However, as the desired effect is usually immediate reduction of numbers, it is concluded that there seems to be no object in adding borax to baits.

[Kozhevnikov (P. V.), Dobrotvorskaya (N. V.) & Latuishev (N. I.).] **Кожевников (П. В.), Добротворская (Н. В.) и Латышев (Н. И.). A Study of Dermal Leishmaniasis.** [*In Russian.*]—9×6 ins., 372 pp., 126 figs., 19 pp. refs. Moscow, Medgiz, 1947. Price 32 *rub.* 50 *kop.*

This book on dermal leishmaniasis is based on the literature and on investigations by the authors and others in the Soviet Union. In the general part, information is given on the nature of the disease, and it is pointed out that the terms " dry " and " moist ", applied to the two chronic and immunologically distinct types existing in Central Asia [*cf. R.A.E.*, B **34** 207], are not strictly correct, as the dry form usually becomes moist though at a later stage in the development of the infection. This part is followed by a history of the disease in different parts of the world from antiquity to the present time, with special reference to Central Asia, and sections dealing with its etiology, including the morphology and systematic position of *Leishmania tropica*, the causal agent, symptoms of the two central Asiatic forms of the disease, pathological history, immunity and treatment. A section dealing with epidemiology contains a chapter on the reservoirs of the two types of the disease in Central Asia [*cf.* **32** 172 ; **34** 77], and another on sandflies (*Phlebotomus*), which are the vectors ; this includes accounts of the morphology, classification, bionomics and ecology of sandflies, lists of those that occur in various parts of the Soviet Union, and notes on the importance of individual species in transmission. The final section deals with methods of destroying the wild rodents that harbour the disease and the sandfly vectors [*cf.* **33** 183 ; **34** 78, 79], and measures of personal protection against the latter [*cf.* **34** 183]. There is a classified bibliography and an appendix on the collection of sandflies, the preparation of specimens, dissection, methods of marking living sandflies, and the examination of soil, etc., for the presence of larvae.

[Olenev (N. O.).] **Оленев (Н. О.). On the Simuliidae of the Lower Volga.** [*In Russian.*]—*Priroda* 1940 no. 6 pp. 109–110. Moscow, 1940. **On the blood-sucking Dipterous Insects of the Lower Volga.** [*In Russian.*] —*Op. cit.* 1945 no. 2 pp. 74–75, 1 fig. 1945.

It is stated in the first of these papers that great numbers of Simuliids attacked man and domestic animals between 11th and 26th June 1939 in the district of Saratov, on the lower Volga, where these flies had not been common for some ten years. All those collected at a spot about ten miles from the river proved to be *Simulium maculatum*, Mg. The summers of 1938 and 1939 were exceptionally dry.

Observations in 1940, recorded in the second paper, showed that pupae of *Simulium matthiesseni*, End., and *S. maculatum*, Mg., were present in the lower Volga and those of *S. ornatum*, Mg., *S. aureum*, Fries, *S. latipes*, Mg., and *S. venustum*, Say, in streams in the environs of Saratov; adults of the first two species were common on islands in the river and at places some 10–12 miles from it. The development of Simuliids in the Volga is affected by the temperature of the water and its level after the spring floods. There is only one generation a year near Saratov, the river freezes about mid-December and the ice breaks about mid-April. The overwintered larvae are then carried by the flood water for considerable distances, settle on the submerged branches of trees or shrubs on the banks and islands, and pupate in May, when the temperature of the water rises to 10°C. [50°F.] or more. The floods recede in the second half of May and in June, when the temperature of the water is 12–15°C. [53·6–59°F.] and that of the air 17–20°C. [62·6–68°F.]. The adults emerge and are active for about three weeks in June, attacking man and animals, and the females oviposit about the end of June, when the temperature of the water is 18–20°C. [64·4–68°F.]. The resulting larvae hatch in July and hibernate.

The Ceratopogonids, *Culicoides stigmaticus*, Kieff., *C. pictipennis*, Staeg., and *C. odibilis*, Aust. (*winnertzi*, Edw.), were also common near Saratov, and *C. fascipennis*, Staeg., on the islands. They were most numerous from 7th to 27th June, disappeared early in July, and, like the Simuliids, caused great annoyance to the agricultural population.

In experiments, burning sticks of dried thyme (*Thymus marschanialis*), which grows in abundance near Saratov, afforded good protection from blood-sucking flies. They were $\frac{1}{3}$ in. thick and 6 ins. long and smouldered for an hour [*cf. R.A.E.*, B **34** 42].

[Olenev (N. O.).] **Оленев (Н. О.). Contribution to the Study of the Enemies of Pasture Ticks.** [*In Russian.*]—*Priroda* 1941 no. 3, 1 p., 1 fig. Moscow, 1941.

Larvae of the Phorid, *Megaselia rufipes*, Mg., were repeatedly observed in test-tubes containing examples of *Ixodes ricinus*, L., collected in different districts of the Province of Leningrad. Thus, at the beginning of August 1940, active larvae were found in a test-tube containing females of this tick that had been taken in various stages of engorgement on cattle in the south of the Province (Lake Selinger) on 20th July. The larvae had evidently emerged from the ticks and had destroyed all the internal organs of some of them; they pupated, and the first adults emerged on 11th September. The larvae of *M. rufipes* are known to be saprophytic and polyphagous, but have not previously been recorded as attacking ticks, though some Phorids parasitise beetles, ants and other Arthropods.

Papers noticed by Title only.

Douglas (J. R.). **The internal Anatomy of *Dermacentor andersoni* Stiles.**—*Univ. Calif. Publ. Ent.* **7** no. 10 pp. [3–] 207–271, 26 figs., 2 pp. refs. Berkeley, Cal., 1943.

Wigglesworth (V. B.). **The Principles of Insect Physiology.**—3rd edn., 10×6¼ ins., viii+434 pp., 316 figs., refs. London, Methuen & Co., Ltd., 1947. Price 30*s*. [*Cf. R.A.E.*, B **27** 169.]

TOUMANOFF (C.). **Les tiques (Ixodoidea) de l'Indochine. Recherches faunistiques avec indications sur les Ixodidés des pays voisins. Notions générales sur la biologie et les moyens de combattre ces Acariens.**—[3]+ii+220 pp., 94 pls., 13 pp. refs. Saigon, Inst. Pasteur Indochine, 1944.

The introductory section of this book comprises information on the collection and study of ticks and on their general external structure and classification. The main part is the systematic section, which contains descriptions of the ticks recorded from Indo-China (including four new species, one new subspecies and one new variety), keys to the species of the principal genera and notes on ticks of the Far East that have not yet been recorded from Indo-China, with brief descriptions of some of them. Practically all the species from Indo-China were studied there by the author, and nearly all the descriptions are accompanied by original illustrations. Host records for Indo-China are given and also data on distribution and hosts elsewhere.

The remaining sections are of a more general nature. A summary of the biology of ticks is given, together with data from the literature on the bionomics of eight of the genera occurring in Indo-China. Tick-borne diseases of man and domestic animals throughout the world are reviewed, and notes on tick paralysis in man and animals and the effect of tick infestation on dairy cattle are included. There are also lists, taken from the literature, of ticks that are known or thought to carry diseases of man or animals or cause tick paralysis in various parts of the world, and of species found on domestic animals in India, Formosa and the Netherlands Indies. The ticks that have been taken on domestic animals and man in Indo-China are *Amblyomma testudinarium*, Koch, on man, dog and horse, *Rhipicephalus haemaphysaloides*, Supino, on dog, *R. sanguineus*, Latr., on man, dog and cattle, *Haemaphysalis bispinosa*, Neum., on man and cattle, *H. spinigera*, Neum., on cattle, *Nosomma monstrosum*, Nutt. & Warb., on buffalo and cattle and *Boophilus annulatus microplus*, Can. (*australis*, Fuller) which was abundant in Tonkin on cattle suffering from piroplasmosis and is considered the probable vector. Methods of controlling ticks are reviewed in the last chapter.

LE GAC (P.), SEITE (P.) & COMBESCOT DE MARSAGUET (G.). **Etude sur le paludisme à Ouagadougou.**—*Bull. Soc. Path. exot.* **38** no. 7–8 pp. 201–216, 1 map. Paris, 1945.

Preliminary studies at Ouagadougou in the Ivory Coast showed that a considerable rise in malaria incidence among the European garrison in December 1941 and January 1942 could be attributed to an increase in the number of Anophelines breeding in a large marshy stream passing through the centre of the town. The terrain is very flat and the nature of the soil favours the formation of temporary pools in the wet season. This sets in in the middle of May, reaches its height in August and ends in October. A dry wind blows from the east from October to February and a wet one from the south-west during the rainy season. Cases of malaria among natives are most numerous from December to March and in August and September, but seasonal fluctuations in rate are not great and reveal endemicity without true epidemic outbreaks. The rise in the wet season is attributed to transmission by Anophelines breeding in temporary pools, and that in the dry season to relapses due to the fall in temperature. Ouagadougou is one of the most malarious centres in West Africa. Examination of 2,942 children between the ages of two and 12 years from the town itself showed that 37·15 per cent. had enlarged spleens, 53·67 per cent. had parasites and 14·81 per cent. were gametocyte carriers. The corresponding figures for 808 children from the outskirts of the town were 44·55, 50·49 and 22·76. Of 1,987 blood samples positive for *Plasmodium*, 93 per cent.

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contained *P. falciparum* (*praecox*, auct.) and 7 per cent. *P. vivax*. Examinations were made in the wet season only. *Anopheles gambiae*, Giles, is the most abundant Anopheline breeding in the marshes, but *A. funestus*, Giles, comprised 5–6 per cent. of the total. The former prefers hoof-prints and the latter little pools protected by twisted roots and islets remote from the areas visited by herds of animals. Larvae of *Anopheles* (principally *A. nili*, Theo., but frequently *A. gambiae*) were found in 822 of the 1,880 wells examined. The wells are shallow and dry up for two or three months at the end of the dry season. At this time, the population depend on the streams for water.

Clearing of the edges of the principal marsh, and felling and clearing of the stumps of trees in it improved the malaria situation immediately in 1942, but were inadequate to deal with it completely as shortage of supplies prevented their being supplemented by oiling. Drainage of the central stream after removal of the dam installed in the past to conserve the water was therefore resorted to, as filling was impracticable on account of lack of time and labour. It is intended to canalise the stream and thus prevent stagnation. A few weeks after operations were begun much of the reclaimed land was under cultivation. The provision of a water supply for the months of March and April to replace the stream is discussed.

KARTMAN (L.). **A Note on the Problem of Plague in Dakar, Senegal, French West Africa.**—*J. Parasit.* **32** no. 1 pp. 30–35, 2 figs., 5 refs. Lancaster, Pa., 1946.

From 1914 to the end of 1944, there were outbreaks of plague in 18 years at Dakar, with a total of 6,562 recorded cases, including 567 cases with 91 per cent. mortality between April and November 1944 [*R.A.E.*, B **34** 49]. Of 3,501 rats examined during these months, only 1·8 per cent. were infected. Data obtained by the Pasteur Institute at Dakar showed that in 1933, 1935, 1936 and 1939, *Xenopsylla cheopis*, Roths., formed 72·9, 71·0, 80·3 and 85·7 per cent., respectively, of the fleas on rats, the remaining species being *Echidnophaga gallinacea*, Westw., *Ctenocephalides canis*, Curt., and *Synosternus pallidus*, Tasch. Of fleas from the floors of native huts, however, where they are abundant and feed almost exclusively on man, *S. pallidus* represented 80·15 and 90·7 per cent. in 1934 [**25** 74] and 1939, whereas *X. cheopis* represented only 1·1 and 0·7 per cent. All fleas collected from hut floors in Dakar and 11 surrounding villages in 1944 and 1945 and identified were *S. pallidus*, except in two villages where *E. gallinacea*, the only other species, represented 1 and 99 per cent. of the population, its local predominance being explained by the presence of many fowls in the huts.

To form an estimate of the flea populations of native dwellings, five huts in one village were examined on each of 11 days between 4th May and 9th July 1944 by exposing sheets of adhesive fly paper successively in three places on the sandy floor between the feet and waving the hands slowly over them for a total period of five minutes. The 13,059 fleas collected represented a density of 237·43 per hut. The sexes were about equally represented and some 40 per cent. had taken a recent blood-meal. In 1939, the number of fleas per rat on 12,259 rats was found to be 1·04 and the *cheopis* index was therefore about 0·96. Thus, the available numbers of *X. cheopis* are negligible compared with the fleas in huts and on man. The percentage of *S. pallidus* on rats is greater than the percentage of *X. cheopis* in huts. On the basis of circumstantial evidence, it is suggested that *X. cheopis* is the primary vector of plague from rats to man and *S. pallidus* a vector from man to man and possibly from rats to man also.

PALMER (E. D.). **Intestinal Canthariasis due to** *Tenebrio molitor*.—*J. Parasit.* **32** no. 1 pp. 54–55, 8 refs. Lancaster, Pa., 1946.

A case of infestation of the intestinal tract of an infant by *Tenebrio molitor*, L., is described. The child began to vomit frequently at the age of four

months and between the ages of five and eight months passed several white objects by rectum, six of which were collected and identified as larvae of *T. molitor*. All were active when passed and two were alive after two weeks in a dry air-tight jar. The child continued to gain weight throughout the period but vomited, cried and took his food poorly. Enemas and purges were ineffective. Adult Tenebrionids were later recovered from boxes of the pre-cooked cereal on which the infant had been fed from the age of three weeks. Because of the age of the child and the long period over which the larvae were passed, it is assumed that infestation was the result of the ingestion of eggs.

Olson (T. A.) & Dahms (R. G.). **Observations on the Tropical Rat Mite, *Liponyssus bacoti*, as an Ecto-parasite of laboratory Animals and Suggestions for its Control.**—*J. Parasit.* **32** no. 1 pp. 56–60, 8 refs. Lancaster, Pa., 1946.

A heavy infestation by *Liponyssus bacoti*, Hirst, occurred on hamsters, rats and mice in the animal house of a medical laboratory in Texas in April 1945. Hamsters were particularly susceptible, and several died as a result of infestation. One examined several hours after death still bore 28,000 mites. Rats, mice and guineapigs placed in the infested cages after a dead hamster had been removed died in a short time, apparently as a result of loss of blood rather than disease or the toxic effect of the bites. Feeding mites engorge rapidly, then leave the host and seek a dark, dry place for digestion, moulting and oviposition. Engorged females laid 2–8 eggs each within a period of 30 hours. The eggs sometimes hatched in 24 hours or less, and the larvae could moult to nymphs within a day or two without a blood-meal.

A dust of 10 per cent. DDT in talc gave 99·63 per cent. kill in 28 hours of 21,097 mites found on a guineapig carcass placed in a gallon jar with 4 gm. of the dust. It also gave complete control when a trial application was made to small amounts of heavily infested animal bedding (wood shavings), and a deposit of 200 mg. DDT per sq. ft. from an emulsified xylene solution on a jar in which bedding was subsequently put gave 89·1 per cent. mortality. In a large-scale attempt to control the mites, treatment of animals and fresh bedding with the 10 per cent. DDT dust, sometimes combined with steam sterilisation of the cage, and cleaning the animal house and spraying the walls to a height of six feet with 5 per cent. DDT in kerosene destroyed the mites, and no reinfestation occurred in the course of 1½ months. The treatment had no apparent ill effects on guineapigs, rats and hamsters, but was toxic to female mice, 30 per cent. of which died in 24 hours. Two young mice also died within this time, and many died between the second and eleventh days, probably as a result of the loss of the mothers. All adult males survived.

Yao (Y. T.) & Wu (C. C.). **Notes on the Chinese Species of the Genus *Phlebotomus*. Part VI. Sandflies in Chungking, Szechuan, with Description of a New Species, *Phlebotomus koloshanensis*.**—*J. Parasit.* **32** no. 1 pp. 87–90, 8 figs., 12 refs. Lancaster, Pa., 1946.

During April–October 1943, 875 recumbent-haired sandflies were collected near Koloshan, Chungking. Of these, 607 were *Phlebotomus barraudi*, Sinton, and the remaining 124 males and 144 females belonged to a species here described as *P. koloshanensis*, sp. n.

Kartman (L.), Campau (E. J.), Newcomb (E. H.) & Morrison (F. D.). **A Note on the Noise-making Ability of the Tsetse-fly, *Glossina palpalis* Rob.-Desv. (Diptera, Glossinidae), while in Flight.**—*J. Parasit.* **32** no. 1 p. 91. Lancaster, Pa., 1946.

References cited from the literature reveal some divergence of opinion as to whether *Glossina* makes a buzzing sound in flight. While collecting in Senegal,

the authors observed that the flight of *G. palpalis*, R.-D., is practically silent in the morning, particularly in thick groves, but that a very distinct and characteristic buzz is produced when air temperatures within the grove have risen. The intensity of the noise was directly correlated with temperature and was greatest at midday and in the afternoon.

KARTMAN (L.). **A Note on Anopheline Vectors of *Wuchereria bancrofti* in West Africa.**—*J. Parasit.* **32** no. 1 pp. 91–92. Lancaster, Pa., 1946.

In 1944, 374 females of *Anopheles gambiae*, Giles, and 746 of *A. funestus*, Giles, from four villages near Dakar, in Senegal, were dissected, and 36·6 and 15·6 per cent., respectively, were found to be infected with *Filaria* (*Wuchereria*) *bancrofti*. These two Anophelines were the predominant mosquitos in the villages throughout the year and are thought to be the primary vectors of *F. bancrofti* in the region [*cf. R.A.E.*, B **19** 31–32; **20** 281]. Some cases of elephantiasis were seen.

NEGHME (A.). **The Aerosol Bomb as a Method for determining the Triatomic Index in human Habitations in Chagas' Disease endemic Zones.**—*J. Parasit.* **32** no. 2 pp. 209–210. Lancaster, Pa., 1946.

In experiments made in rural houses near Santiago, Chile, aerosols released by gas pressure from the so-called aerosol bombs containing pyrethrum, sesame oil and Freon 12 (dichlordifluoromethane) showed little toxicity to *Triatoma infestans*, Klug; only 37 Triatomines out of 230 caught in eight houses died within 1½ months. However, 5–10 minutes after the release of the aerosol, the bugs left their hiding places in large numbers and could be very easily caught. This effect was particularly apparent in rooms that had been well sealed before treatment. It is concluded that the pyrethrum aerosol bomb should be of use in surveys for Triatomines in dwellings.

COOLEY (R. A.). **Note on the Tick, *Ixodes angustus* Neumann.**—*J. Parasit.* **32** no. 2 p. 210. Lancaster, Pa., 1946.

The Rocky Mountain laboratory at Hamilton, Montana, has records of three females of *Ixodes angustus*, Neum., biting man, one in Oregon in 1931 and the others in Washington in 1944 and 1945. In no instance was there any suggestion that a disease was transmitted. *I. angustus*, which usually attacks small mammals, is common in Washington, Oregon and California, and occurs sporadically in the other western States as far south as New Mexico, in Alaska as far as about 60°N. lat. and in British Columbia. There are a few records from Maine and Michigan, but none from the central and south-eastern States.

ROZEBOOM (L. E.) & KNIGHT (K. L.). **The *punctulatus* Complex of *Anopheles* (Diptera : Culicidae).**—*J. Parasit.* **32** no. 2 pp. 95–131, 44 figs., 34 refs. Lancaster, Pa., 1946.

The literature on the classification of the mosquitos closely allied to *Anopheles punctulatus*, Dön., is reviewed, and an account is given of detailed morphological studies made of the larvae, pupae and adult females of *A. punctulatus*, *A. koliensis*, Owen, and *A. farauti*, Lav., from various parts of the range of the complex [*cf. R.A.E.*, B **35** 161, 162]. The material consisted of associated larval, pupal and adult specimens collected as larvae from natural breeding places in four widely separated localities and of laboratory-reared progeny from individual females. The localities were Espiritu Santo in the New Hebrides, Guadalcanal in the Solomon Islands, Hollandia in Netherlands New Guinea, and Morotai in the Moluccas. Methods of preparing larval and pupal skins for study are given.

Principally on the basis of the coloration of the proboscis, *A. punctulatus*, *A. koliensis* and *A. farauti* are considered to be systematically distinct. No area was discovered in which blending of the strains was apparent. *A. punctulatus*, which is separable from the other two in the larval, pupal and adult stages, is regarded as a full species, and the constancy of the proboscis pattern among all but a few of the progeny of *A. farauti* and *A. koliensis* is interpreted to mean that these two are distinct from one another. Although they are much more closely related to one another than to *A. punctulatus*, they are considered to be of specific rank because their immature stages can be found together in the same breeding places.

The mosquitos with the completely dark labium of *A. farauti* [*R.A.E.*, B **33** 79] from Espiritu Santo, Guadalcanal, Hollandia and Morotai all belonged to the same species, no important difference between them being noticeable. Hence, the name *moluccensis*, Sw. & Sw. [**8** 136] becomes a synonym of *farauti* [*cf.* **34** 122 ; **35** 162]. *A. punctulatus* of Guadalcanal was found to be identical with *A. punctulatus* of Hollandia. *A. koliensis* of Guadalcanal and the New Guinea form with the small ventral white patch on the labium that has been regarded as *moluccensis* [**33** 79 ; **35** 161] were the same, and if cross-breeding experiments show that this mosquito is not a hybrid, the name *A. koliensis* must be applied to it. Preliminary experiments on the cross-breeding of *A. punctulatus* and *A. farauti* from Guadalcanal failed to yield progeny. The larva, pupa and adult female of *A. clowi*, sp. n., a new member of the complex, are described from a single specimen bred from a larva collected in a road rut in Hollandia in March 1945, and keys are given for separating the fourth-instar larvae, pupae and females of *A. punctulatus*, *A. farauti*, *A. koliensis* and *A. clowi*.

WOODHILL (A. R.). **Observations on the Morphology and Biology of the Subspecies of *Anopheles punctulatus* Dönitz.**—*Proc. Linn. Soc. N. S. W.* **70** pt. 5–6 pp. 276–287, 3 figs., 1 map, 3 refs. Sydney, 1946.

Lee & Woodhill, in a recent paper [*R.A.E.*, B **33** 193], considered *Anopheles moluccensis*, Sw. & Sw., to be a subspecies of *A. punctulatus*, Dön., and suggested that forms intermediate between them were hybrids. They also pointed out that if the form with the dark proboscis, occurring in the New Hebrides and described in 1902 by Laveran as *A. farauti*, could not be differentiated from *moluccensis* from Australia and New Guinea, then the name *farauti* would have priority. It is adopted in this paper in view of the work of Belkin, Knight & Rozeboom [**35** 161, 162], but the author still prefers to consider the mosquito to which he applies it as a subspecies of *A. punctulatus*. The characters by which the larvae and adults of the two forms are differentiated by Lee & Woodhill are given. The adults are differentiated only by the labium being entirely dark in *farauti* and having the apical two-fifths pale in *punctulatus*. In the larvae, the shoulder hairs provide the most reliable character, as antennal colouring is of value in certain districts only. Since the publication of Lee & Woodhill's paper, it has been noticed that the palmate hair of the the first abdominal segment also has some diagnostic value.

In the course of detailed observation made at Salamaua, New Guinea, from May to July 1944, a breeding place was found in which the larvae showed all variations in antennal coloration, but had shoulder hairs typical of *punctulatus*. Some 350 adults were bred from this series, and all were *punctulatus*. The breeding place was unusual for *punctulatus* ; it was a weedy, partly shaded, grass-grown pool resembling the breeding places of *farauti*, and the larvae occurred under floating grass. All the larvae of *punctulatus* found in sunlit muddy pools without macroscopic vegetation had the usual pale antennae with dark tips. It is suggested that antennal coloration is an environmental character.

There were three distinct breeding areas at Salamaua, of which the central one differed from the others. In the latter, the larvae occurred in open sunny wheel ruts free from vegetation and with water usually containing a dense suspension of clay, and only *punctulatus* was observed. The central area included some sunlit wheel ruts, but consisted mainly of muddy, sometimes shady, pools in vegetable gardens, small grassy swamps, seepages and drains. Light to heavy breeding of *punctulatus* and very light breeding of *farauti* were found, both occasionally occurring in the same pool, and it was obvious that fairly extensive breeding of *farauti* was taking place in the neighbourhood. Large numbers of adults of both were taken when the temperature was high and the weather calm, about half of them on walls, etc. No such positions were searched in the other two areas, where there were no human communities and practically no adults were taken, though catches were made near prolific breeding places. No adults were found resting in tents or huts during the day. Of the 977 females taken in night catches in the central area between 26th May and 4th July 1944, 54·3 per cent. were *farauti*, 26·8 per cent. *punctulatus* and 18·9 per cent. intermediate forms of all types. There was a fairly steady rise in catches during the night, with the peak between midnight and 5 a.m., and no significant difference between *punctulatus* and *farauti*. Atherton, however, working at Lalapipi, found that the peak period of adult abundance of *farauti* was about 9 p.m. An account is given of an attempt to establish a laboratory culture of *punctulatus* in a cage measuring $8 \times 9 \times 15$ ins. From an original stock of adults including about 200 females, some 50 adults of the next generation were obtained, but none of these laid eggs. It appears that under these conditions only a few adults pair.

To study the morphology of adults and larvae from the central area, examples from eggs obtained from single females caught in the field and classified as *punctulatus*, *farauti* or intermediates were reared to the adult stage and examined. Among the progeny of the two females classed as *punctulatus*, most larvae had all the characters of *punctulatus* but seven showed some characters of *farauti*. All the adult progeny resembled *punctulatus*. The two females classed as *farauti* gave rise to larvae and adults all of which showed the characters of *farauti*. The six females classed as intermediate gave rise to larvae and adults that showed a complete range of variation from *farauti* to *punctulatus* except in the first abdominal palmate tufts of the larvae, which were all typical of *punctulatus*.

These observations and experiments are thought to support the theory that the intermediate forms are hybrids between *farauti* and *punctulatus* [*cf.* preceding abstract] as both were breeding together in the area where the intermediate forms were obtained, whereas only *punctulatus* appeared to be breeding in the others. Moreover, no intermediates have been recorded in very extensive collections from areas where *farauti* occurs alone, but they have been taken from most localities in New Guinea where *punctulatus* and *farauti* occur together. The percentage of intermediate forms was as high as 80 at Salamaua but only a few were found in Milne Bay. It is pointed out that the findings of Owen and of Belkin, Knight & Rozeboom [**35** 161, 162] in the Solomon Islands do not apply in certain areas in New Guinea and Australia. One of the intermediate females from which progeny was bred had the proboscis coloration described for *A. koliensis*, Owen, while some individuals among its progeny had the proboscis either identical with *punctulatus* or intermediate between this and *koliensis*. Another female with a proboscis of the *koliensis* type gave rise to progeny some of which had a *farauti* proboscis. Owen also states that *koliensis* can usually be separated from *punctulatus* by the absence of a small dark spot on the costal margin of the wing between the basal and median dark spots. Among the progeny of two females from Salamaua with the proboscis coloration of *punctulatus*, 7 out of 38 and 7 out of 21, respectively, lacked this black spot, and in many hundreds of specimens of both *punctulatus* and *farauti* examined

from New Guinea and Australia, this character was found to be extremely variable. Also, the character given by Belkin, Knight & Rozeboom for separating larvae of *farauti* from those of *koliensis* and *punctulatus* was found to be invalid for the author's reared material and for material from the Northern Territory of Australia. The examination of thousands of specimens of the subgenus *Myzomyia* from various widely separated parts of the Australasian Region, revealed the extreme variability of such characters as those used for distinguishing members of the *punctulatus* complex. They are frequently constant in a restricted area, but variations almost always occur when specimens from widely separated areas within the Region are examined. It would seem, therefore, that *koliensis* exhibits constant characters in the Solomon Islands, but that examples from New Guinea, morphologically identical with it, give rise to *punctulatus* and *farauti* in their progeny. The author therefore considers it more logical to regard *koliensis* as a subspecies of *punctulatus* than as a distinct species.

TAYLOR (F. H.). **Contributions to a Knowledge of Australian Culicidae. No. VIII.**—*Proc. Linn. Soc. N.S.W.* **70** pt. 5–6 pp. 211–212, 1 fig. Sydney, 1946.

In this paper, which belongs to a series [*cf. R.A.E.*, B **33** 134], *Aëdes clintoni*, sp. n., is described from New Guinea, and *Anopheles atratipes*, Skuse, and three other mosquitos are recorded from New South Wales, two of the latter for the first time. *A. atratipes* was fairly common at Byron Bay and was twice taken biting in full sunlight.

[BEKLEMISHEV (V. N.) & ZHELOKHOVTZEV (A. N.).] **Беклемишев (В. Н.) и Желоховцев (А. Н.). Les aires de plusieurs espèces d'Anophèles de l'URSS et les facteurs dont elles dépendent.** [*In Russian.*]—*Bull. Soc. Nat. Moscou* Sect. biol. (N.S.) **50** no. 1–2 pp. 56–73, 6 maps. Moscow, 1945. (With a Summary in French.)

The effect of climate in limiting the spread of mosquitos is discussed and illustrated by a survey of the world distribution of seven species of *Anopheles*; it appears that no species of this genus can survive in any area in which the conditions do not allow it to complete at least two generations a year. The species considered are those that are the commonest in the Soviet Union, viz., *Anopheles pulcherrimus*, Theo., *A. superpictus*, Grassi, *A. algeriensis*, Theo., *A. plumbeus*, Steph., *A. claviger*, Mg. (*bifurcatus*, auct.), *A. hyrcanus*, Pall., and *A. maculipennis*, Mg.

Of these, *A. pulcherrimus* requires the highest temperature and is also the most resistant to dryness [*cf. R.A.E.*, B **34** 179]. It can exist only in regions with a hot summer that lasts about four months; the optimum average daily temperature for the larvae is over 30°C. [86°F.] and the adults thrive at temperatures up to 33°C. [91·4°F.]. It occurs chiefly in valleys of rivers traversing desert or semi-desert and can survive short winters with moderate frost, since it hibernates in the larval stage. It has not been recorded at altitudes above about 4,300 ft. [*cf.* **28** 183], or to the north of a line delimiting the regions in which there are at least 110 days a year with an average daily temperature of 20°C. [68°F.] or more. Accordingly, it is found from the dry steppes in eastern Transcaucasia to the Persian Gulf in the south, and to the source of the Ganges in the east. The south-eastern limit of its distribution in India approximately coincides with the boundaries of the zone in which the relative humidity during the day is 71–81 per cent. in July, August and September. In the south-west, its distribution is probably checked by the arid deserts of Arabia and Syria.

A. superpictus occurs chiefly along the Mediterranean and in parts of Central Asia with a Mediterranean climate, characterised by a hot dry summer. The

larvae, unlike those of *A. pulcherrimus*, which are most numerous in the flood-lands of large rivers, are usually found along the pebbly banks of streams and small rivers in foot-hill regions, though they occur along the Amu-Dar'ya right down to the delta. *A. superpictus* is less sensitive to lack of heat than *A. pulcherrimus*, and its distribution consequently extends further north, being limited in Europe and the Caucasus by the occurrence of cool damp summers and in Central Asia by the severe winters of Kazakstan, where the northern limit of its distribution approximately coincides with the January isotherm of −7°C. [19·4°F.]. It is also less affected by precipitation, especially in winter, when only females are present and these are hibernating in shelters. In summer, heavy rains in the mountains destroy the larvae in the streams, and the species cannot survive in areas in which such rains are frequent. In the south, the distribution of *A. superpictus* is limited by the Sahara, and in India its south-eastern boundary runs along the border of the monsoon area, the rainy summer of which is detrimental to it.

A. algeriensis, which shows the greatest preference for humidity of any *Anopheles* in the Soviet Union, requires a protracted, moderately warm season. The larvae develop and hibernate in swamps fed by subterranean water and shaded by reeds, with a temperature of 10–20°C. [50–68°F.] [*cf.* **26** 166]. Their development is therefore slow, and in order to complete the necessary two generations a year, *A. algeriensis* requires a minimum of 190 days with a temperature above 10°C. It finds such conditions on the Atlantic coast of Europe, with a long spring and autumn, and on the Mediterranean. In western Europe it occurs up to 53°N. lat. (Hamburg), but in the Soviet Union, only up to 43°N. lat. (Kizlyar in Daghestan), at which two points there are 210 days in the year without frost. The southern limit of its distribution in Asia and North Africa runs parallel to, but somewhat lower than, the annual isotherm of 20°C., south of which the water in the swamps is probably too warm for the larvae to survive.

The distribution of *A. plumbeus* more or less coincides with that of *A. algeriensis*, since its larvae cannot develop normally in water of which the temperature is much above 20°C., and it requires a moderately warm long season. It is the only European *Anopheles* that breeds in tree-holes, hibernating in them in the egg or larval stage [*cf.* **31** 156, 157], and since the water in the tree-holes in summer is warmer than that in the breeding places of *A. algeriensis*, its distribution extends further north than that of *A. algeriensis*, reaching 60°N. lat. in Scotland, 56° in Denmark and 50° in the Ukraine. It occurs in deciduous forests throughout the Caucasus, but in Central Asia it has only been found in the humid forest-covered gorges in the Karakala region (south-western Turkmenistan). Its southern boundary runs along the Mediterranean.

A. claviger, which shows a greater preference for cold than either of the two preceding species, is present almost throughout Europe and has been found in European Russia and western Siberia up to 60°N. lat. It does not occur so far south as *A. algeriensis* in North Africa, and is rare in summer in Central Asia and Transcaucasia owing to the heat.

A. hyrcanus occurs over large areas in Asia and southern Europe in which the summer is warm, but not excessively so. Its northern limit coincides over much of its range with the July isotherm of 20°C., though it does not reach this in eastern Europe and extends considerably further north in the Russian Far East. It is the chief vector of malaria in northern and central China, and the only one, though not very efficient, in Japan, Korea and the Ussuri region of the Russian Far East. Probably owing to the hot summers, it is absent from Arabia and the region of the lower Indus. In the northern part of its range, such as the Ukraine, the lower Amur or the Maritime Province, it breeds in warm water exposed to the sun, and reproduces chiefly during the hottest months. In southern regions, such as Turkestan or the Caucasus, it breeds in

shaded, cool, reedy swamps and reproduces throughout the summer, and in certain parts of India and Indo-China, it is abundant only in the coolest part of the year.

A. maculipennis occurs in North Africa, all Europe, except the extreme north, Central Asia, northern Asia, except part of the Russian Far East [*cf.* **25** 145], western Alaska, Canada and the United States, extending southwards in the west of North America to Mexico City. Its spread in northern Eurasia is limited by the southern edge of the taïga forest belt since there are no suitable breeding places in dense forest. It penetrates gradually, however, where the forest is cleared and settlements are established. Its climatic limit of distribution appears to coincide with that of the zone in which there are at least 85 days a year with a mean daily temperature above 10°C. and the mean monthly temperature in July is 15°C. [59°F.]. Thus it only reaches to 56° 38′ N. lat. in Scotland, whereas it occurs in the Soviet Union up to 65° N. lat. in Karelia and Yakutia. Its southern boundary is determined by the occurrence of hot dry summers, and is thought to coincide in some places with the July isotherm of 30°C. [86°F.]. It is, therefore, absent from the hotter regions of Central Asia. Its southern limit in Mongolia and China has not been traced.

A. maculipennis does not reach the Pacific ocean anywhere in eastern Asia, though suitable breeding places are available, and has not been observed further east than Blagoveshchensk, on the estuary of the Zeya, to the east of which *A. hyrcanus* alone is found [*cf.* **25** 145]. The reason for this is not known, but it may be due to competition between the larvae of the two species, since both occur in the same sort of breeding places near the northern limit of the distribution of *A. hyrcanus*, whereas further west the latter occupies much more shaded waters and competition is thus excluded.

The geographical distribution of the varieties of *A. maculipennis*, which was dealt with in an earlier work by the authors [**26** 239], is briefly reviewed.

CAMBOURNAC (F. J. C.) & PITTA SIMÕES (J. M.). **Sôbre a produção de *Anopheles* nos arrozais de Aguas de Moura.** [On the Production of *Anopheles* in the Rice Fields of Aguas de Moura.]—*An. Inst. Med. trop.* **1** fasc. 2 pp. 229–239, 2 pls., 2 refs. Lisbon, 1944.

The method of counting the larvae of *Anopheles maculipennis*, Mg., var. *atroparvus*, van Thiel, in the water of rice-fields at Aguas de Moura, Portugal, that was described by Cambournac in 1939 [*R.A.E.*, B **27** 233] was used in preliminary tests there in 1938 and in more detailed investigations in 1939–41. The results are given in tables and show that the maximum larval population was reached in May and early June, when up to 432 larvae per square metre were present. Changes in the relative numbers of larvae of the different instars were attributed to the effects of rain, wind and, in spring, changes of temperature. Pupae became extremely rare or disappeared entirely from June onwards in each year, although larvae, even individuals in the fourth instar, were still common. The cause of this was not ascertained; it was apparently not due to natural enemies, the temperature or chemical composition of the water, or food supplies, but may have been partly connected with the effect of increasing shade. The numbers of adults taken at suitable spots during the season rose with the numbers of pupae present in the rice-fields, but were maintained for about two months after the disappearance of the latter. Since no adults emerge after about mid-June, control measures against the larvae are not necessary after the end of that month.

A. claviger, Mg., was also present in the district, but bred only in springs of clear water and is not important as a vector of malaria [*cf.* **31** 77].

Cambournac (F. J. C.). **Culicidae (Diptera, Nematocera) da região de Águas de Moura.** [Mosquitos of the Region of Aguas de Moura.]—*An. Inst. Med. trop.* **1** fasc. 2 pp. 247–268, 2 pls., 18 refs. Lisbon, 1944.

A list is given of 16 species of mosquito found in the region of Aguas de Moura, Portugal, showing their synonymy. The only Anophelines included are *Anopheles maculipennis*, Mg., var. *atroparvus*, van Thiel [*cf. R.A.E.*, B **31** 78], and *A. claviger*, Mg. The egg-characters of the local form of *atroparvus* and the bionomics and ecology of all the species are briefly discussed, and keys are given to the larvae and adults of both sexes of the five species of *Aëdes*.

de Meira (M. T. V.) & Ferreira (T. G.). **Espèces de phlébotomes de Lisbonne et de ses environs.**—*An. Inst. Med. trop.* **1** fasc. 2 pp. 269–288, 5 pls. (2 col.), 2 figs., 5 fldg. tables, 32 refs. Lisbon, 1944. (With a Summary in English.)

Sandflies captured in the neighbourhood of Lisbon in 1942–43 comprised *Phlebotomus perniciosus*, Newst., *P. sergenti*, Parr., *P. minutus*, Rond., and *P. ariasi*, Tonn., of which the first was by far the most numerous and the last two had not previously been recorded in Portugal. *P. papatasii*, Scop., which was reported near Lisbon in 1911 [*cf. R.A.E.*, B **1** 73], was not encountered. Most of the sandflies were taken in cattle-sheds, and some in stables, rabbit-hutches, fowl-houses, pigsties, kennels and occasionally in dwellings. They were found from April to October and were most numerous in July and August. The method of catching the sandflies in test tubes and mounting specimens is described. The morphology of all four species is discussed, and tables are given showing their body measurements. Keys to the males and females of all the five Portuguese species are appended.

da Cruz Ferreira (F.) & Ferreira (T. [G.]). **Sôbre a biologia das espécies de *Phlebotomus* de Lisboa e arredores.** [On the Biology of the *Phlebotomus* Species of Lisbon and its Neighbourhood.]—*An. Inst. Med. trop.* **1** fasc. 2 pp. 289–313, 1 pl., 5 figs., 1 fldg. table, 42 refs. Lisbon, 1944. (With Summaries in English and French.)

Further examples of *Phlebotomus* were taken between May and November 1944 in buildings in the vicinity of Lisbon [*cf.* preceding abstract]. They were scarce in buildings that were clean and well-ventilated, but appeared to be favoured by an average temperature of 27·5°C. [81·5°F.], a relative humidity of 84–56 per cent., reduced illumination and the absence of wind. They were nocturnal in habit, resting during the day in dark corners high up near the roof, wherever cobwebs were abundant. Most examples were taken in August and September. No larvae were found, although numerous apparently suitable sites were investigated.

In precipitin tests for the blood of cattle, dogs, equines, birds and man in 600 females taken with fresh blood in their stomachs, 406 gave no reaction, more than half the remainder had fed on cattle, smaller numbers on dogs, equines and birds, and only one on man. Over 300 examples, including some from a house in which a child was suffering from visceral leishmaniasis, were examined for the presence of leptomonads in the proboscis or digestive tract, but none was found.

Laboratory rearing of *Phlebotomus*, particularly *P. perniciosus*, Newst., was begun, using apparatus so designed that the cultural medium was automatically kept damp. The medium usually consisted of the excreta of guineapigs, previously sterilised and macerated in water, on which dried rose leaves or a mixture of pulverised garden earth and powdered horse-blood (5 : 1) was scattered from time to time. The development of fungi in the rearing-tubes did not have any adverse effect on the larvae. At first, when gravid females were

placed in the tubes, many of them died in 2–3 days, before completing oviposition, but when a small piece of cotton-wool soaked in sugar water was put in each tube the females survived for five days. Both egg-laying and the subsequent development of the larvae were found to be more successful when the tubes were kept at a temperature of about 27°C. [80·6°F.]. Oviposition generally took place 3–9 days after capture, and approximately 30–40 eggs were laid by each female. The egg, larval and pupal stages lasted 3–15, 18–30 and 6–10 days, respectively.

Cambournac (F. J. C.) & Pitta Simões (J. M.). **Observações sôbre a eficácia de vários métodos de combate às larvas dos géneros** *Anopheles* **e** *Chironomus*, **nos viveiros dos arrozais.** [Observations on the Efficacy of various Methods of controlling the Larvae of *Anopheles* and *Chironomus* in Rice Seed-beds.]—*An. Inst. Med. trop.* **1** fasc. 2 pp. 315–325, 7 refs. Lisbon, 1944.

The results are given of tests in rice seed-beds at Aguas de Moura, Portugal, of various insecticides for the control of larvae of *Chironomus*, which injure the seedlings [*cf. R.A.E.*, A **35** 353], and of *Anopheles maculipennis*, Mg., var. *atroparvus*, van Thiel. Calcium cyanamide, either as a suspension in water or mixed with road dust, was ineffective, and copper sulphate and chloride of lime (containing 10 or 20 per cent. free chloride) were effective only at concentrations harmful to the rice. A mixture of Paris green and road dust (1 : 100) at a rate of 1 oz. per 10 sq. ft. of water surface resulted in a complete kill of *Anopheles* larvae in two days, but Paris green was ineffective in a water suspension with castor oil and egg albumin [*cf.* B **29** 112], possibly because the particle size was too great. Satisfactory control of both *Anopheles* and *Chironomus* was obtained with creolin, which was cheap and harmless to the plants ; the danger to natural enemies of the mosquito was not important under the circumstances. It was used at final concentrations of 1 : 20,000 or 1 : 30,000 and applied in water by means of a watering-can. A mixture of 10 pints creolin, 8 pints petrol, 1 pint turpentine and 20 oz. naphthalene gave similar results. Complete control of both pests was also obtained by draining a plot for five days [*cf.* B **29** 97], and the growth of the plants was in no way impaired.

Cambournac (F. J. C.) & Pitta Simões (J. M.). **Nota sôbre alguns ensaios realizados com Neocid e 7013 Geigy contra as larvas de** *Anopheles*. [A Note on some Tests carried out with Neocid and 7013 Geigy against Larvae of *Anopheles*.]—*An. Inst. Med. trop.* **1** fasc. 2 pp. 383–392, 4 refs. Lisbon, 1944.

Results are given of tests carried out in rice seed-beds at Aguas de Moura, Portugal, in which Neocid (5 per cent. DDT) and a material referred to as 7013 Geigy were applied at 0·2 gm. per sq. metre in suspensions, or at 0·1 gm. per sq. metre mixed with road dust, to the surface of the water for the control of *Anopheles maculipennis* Mg., var. *atroparvus*, van Thiel. Counts of larvae were carried out after each application, and although it was evident that some control had been obtained, the results were extremely erratic and it is concluded that the concentrations used were too low.

Nájera Angulo (L.). **Sobre la existencia en Madrid de casos autóctonos de paludismo y la población anofelina de la Casa de Campo.** [On the Existence in Madrid of Cases of locally-acquired Malaria and the Anopheline Population of the Casa de Campo.]—*Bol. Soc. esp. Hist. nat.* **42** pp. 381–388, 2 figs. Madrid, 1944.

Malaria has been spreading in Spain since the years 1939–40, and the number of cases recorded in Madrid has also increased. It used to be thought that

these were not locally acquired, but in view of the increase, the history of the 1,500 cases identified in the city in 1943 was investigated. When all those in which the disease might have been acquired outside Madrid were eliminated, there still remained some in which local infection must have occurred, and the distribution of these is shown on a map ; the majority were on the outskirts of the city. It was considered unlikely that Anophelines bred in the River Manzanares, though some breeding might possibly have taken place in the vicinity of bridges, and attention was turned to public parks and gardens, particularly that known as the Casa de Campo, where there was an ornamental lake. Investigations there in October showed that the lake was not very suitable for the breeding of *Anopheles*, and no larvae were found in it except those of other mosquitos, but larvae that were subsequently identified as *A. claviger*, Mg., though they were not quite typical, were found in a pond nearby. These were in the second instar and when kept in the laboratory, had not reached the fourth instar by late November ; *A. claviger* overwinters in the larval stage. This species has been recorded from Majorca and from eight provinces in Spain, but not from that of Madrid. It has not hitherto been considered of importance in the transmission of malaria in that country since it usually had little contact with man [*cf. R.A.E.*, B **35** 44], but was doubtless a vector in Madrid, though *A. maculipennis*, Mg., probably also occurs there.

NÁJERA [ANGULO] (L.). **Método nuevo para el transporte de larvas de Culícidos.** [A new Method of transporting Mosquito Larvae.]—*Bol. Soc. esp. Hist. nat.* **42** pp. 471–476. Madrid, 1944.

Mosquito larvae collected for use in the laboratory frequently die before arrival owing to the movement of the water in the receptacles in which they are carried, and this is particularly the case with those of *Anopheles*, which have no respiratory siphon. The author has obtained good results in Spain by transporting the larvae in wet chopped grass, reeds or water weeds in a match-box or other small container and gives examples. In general, the percentages that survived were at least 95 after ten hours, 60 after 11–20 hours and 30 after 21–30 hours.

NÁJERA ANGULO (L.). **Hallazgo de *Phlebotomus* en Galicia y consideraciones sobre la epidemiología de las leishmaniosis.** [Discovery of *Phlebotomus* in Galicia and Considerations on the Epidemiology of Leishmaniases.]—*Bol. Soc. esp. Hist. nat.* **43** pp. 25–30, 2 figs., 8 refs. Madrid, 1945.

The author records the discovery of *Phlebotomus* in certain parts of Spain from which they were not previously recorded, including the north-western province of Orense, where *P. perniciosus*, Newst., and *P. ariasi*, Tonn., were taken in 1944. A map is given showing the distribution in Spain of visceral and cutaneous leishmaniasis and of *Phlebotomus*.

BERTI (A. L.). **Acueductos y cloacas en su relación con el problema de la malaria.** [Water-supplies and Drains in Relation to the Problem of Malaria.]—*Tijeret. sobre Malar.* **9** no. 5 pp. 137–142, 2 pls. Maracay, 1945.

The water supply in many towns in Venezuela is inadequate or faulty, and Anophelines find numerous breeding places in pools due to leakage or overflow and in storage vessels. The species found so breeding in a recent survey were *Anopheles albimanus*, Wied., *A. argyritarsis*, R.-D., *A. darlingi*, Root, *A. pseudopunctipennis*, Theo., *A. rangeli*, Gabaldon, Cova-García & López, and *A. punctimacula*, D. & K.

Carrillo (S.). **Aplicaciones de los métodos simili-naturales en la lucha anti-malárica.** [The Use of Naturalistic Methods in the Control of Malaria.]—*Tijeret. sobre Malar.* **9** no. 5 pp. 142–146. Maracay, 1945.

The author briefly reviews naturalistic methods of controlling the Anopheline vectors of malaria [*cf. R.A.E.*, B **27** 211] and gives an account of the use of two of them in Venezuela. In 1937 work was begun at Puerto Cabello on an extensive breeding place of *Anopheles albimanus*, Wied., formed by the spreading of the San Esteban river where its outlet was blocked by sand. Refuse was tipped into it leading to pollution of the water, and a few weeks after the work was begun, no further larvae of *A. albimanus* were found in it. In October 1943, a salt-marsh containing water with a salt content of 17·5 per cent. was subjected to tidal action by being connected with Lake Maracaibo. The salt content thereupon fell to that of the lake (1·91 per cent.), and algae of the genus *Spirogyra* disappeared. Larvae of *A. albimanus* were numerous in the marsh before the channel was opened but disappeared subsequently and none was taken throughout 1944, though they continued to occur in other salt-marshes nearby. Their disappearance was attributed to the daily fluctuation in water level (about 20 ins.), the reduction in salt content of the water and the action of the larvivorous fish, *Lebistes reticulatus*.

Lairet hijo (F.). **La situación de la fiebre amarilla en Venezuela.** [The Yellow Fever Situation in Venezuela.]—*Bol. Ofic. sanit. panamer.* **24** no. 9 pp. 779–783, 2 maps. Washington, D.C., 1945. (With a Summary in English.)

Jungle yellow fever is endemic in two areas in Venezuela. In the first, which is situated in the east, between the River Caroní and the frontiers of Brazil and British Guiana, the disease has long been known, and an outbreak occurred in the sparsely populated Cuyuní Valley, in the east of it, in 1929. The second was discovered in 1944–45, following the establishment of a yellow fever service in 1937 and the practice of viscerotomy in suspected cases of mortality from the disease ; it is situated in the west, in the States of Táchira and Barinas, with a main focus in the San Camilo forest and another possible one on the northern slopes of the Andes, towards Lake Maracaibo. The first cases there occurred in a sawmill in which seven of nine men who had felled timber in the forest fell ill on the same day, and there were two cases in another sawmill ; mosquitos of the genus *Haemagogus* occurred in both mills. Further cases were found among workers clearing timber areas and jungle where *Haemagogus* occurred, following the felling of the trees, and a monkey (*Ateles belzebuth*) caught in the forest showed a positive reaction when tested for immunity. The workers concerned had arrived from regions where yellow fever does not occur, and 23 per cent. of the local population showed immunity. Both the endemic areas are situated at altitudes of less than 1,650 ft. and have a mean annual temperature of between 25 and 29°C. [77 and 84·2°F.], with abundant rainfall between May and December.

Botsford (R. C.). **Mosquito Control in 1944.**—*Bull. Conn. agric. Exp. Sta.* no. 488 pp. 323–329, 3 refs. New Haven, Conn., 1945.

In addition to the maintenance of ditches in salt marshes, mosquito control work in Connecticut in 1944 included a survey of fresh-water breeding places during the Anopheline breeding season (July to September) to locate the sources of possible vectors of malaria and to determine their abundance. Of the 1,225 water samples taken, 214 contained *Anopheles quadrimaculatus*, Say, which appeared to be distributed throughout the State, though it was most abundant in the south-western part, 777 contained *A. punctipennis*, Say, a poor vector of malaria, and 11, 3 and 1 contained *A. walkeri*, Theo., *A. crucians*,

Wied., and *A. barberi*, Coq., respectively. Larvae of *Anopheles* were taken more frequently than those of all other species combined, and larvae of *A. punctipennis* more than twice as frequently as those of any other single species. Suggestions for carrying out local control campaigns in 1945 are appended.

VARGAS (L.). **Nota sobre** [on] **Ceratopogónidos y** *Culicoides*.—*Rev. Inst. Salub. Enferm. trop.* **6** no. 1 pp. 41–49, 3 figs., 28 refs. Mexico, D.F., 1945. (With a Summary in English.)

The author reviews the literature on the relation of Ceratopogonids to diseases of man and animals, and gives lists of the American species of *Culicoides* and of the 14 species of this genus that occur in Mexico, with records of their local distribution. He figures and describes the male terminalia of *Culicoides cockerelli* var. *tristriatulus*, Hoffman, and figures the wings of *C. copiosus*, Root & Hoffman, and *C. piliferus*, Root & Hoffman.

VARGAS (L.). **Notas sobre la oncocerciasis. I. Consideraciones sobre la población de simúlidos adultos.** [Notes on Onchocercosis. I. On the Population of adult Simuliids.]—*Rev. Inst. Salub. Enferm. trop.* **6** no. 1 pp. 51–59, 1 ref. Mexico, D.F., 1945. **II. El factor luz y los simúlidos adultos.** [Reactions to Light of adult Simuliids.]—*T.c.* pp. 61–66, 9 refs. **III. Algunos factores que afectan la fijación de las larvas de simúlidos.** [Some Factors affecting the Attachment of Simuliid Larvae.]—*T.c.* pp. 67–70. (With Summaries in English.)

In these papers the author describes observations made in January 1945, during the dry season, on an estate in the State of Chiapas, Mexico, in the course of investigations on the habits of the Simuliids of the district, which is at an altitude of about 2,800 feet, and their relation to *Onchocerca volvulus* [*cf. R.A.E.*, B **35** 16]. The first paper deals with the collection of adults. Those that were attracted to children used as bait were *Simulium metallicum*, Bellardi, and *S. ochraceum*, Wlk., which were taken in far greater numbers between 9.30 a.m. and mid-day than between 4 and 5 p.m., and *S. callidum*, D. & Shann., which was somewhat more numerous in the afternoon. Collections were also made by means of light-traps with blue or plain electric bulbs, the latter giving a rather yellowish light. These were operated all night, and were visible for about a mile and a half. Simuliids represented 4·88 per cent. of the total number of insects taken in the traps, and, in addition to the three species already mentioned, included *S. mexicanum*, Bellardi, and *S. virgatum*, Coq.; *S. metallicum* was the most numerous in all cases, and was the only species represented by males. Further tests with this species showed that, in general, many more males were attracted to blue than to yellowish light, but females rather preferred the latter. It is concluded that more accurate information on the anthropophilous species could be obtained by collections made in traps containing human bait, as used for mosquitos.

In the second paper the author discusses, from personal observation and the literature, the behaviour of adult Simuliids in captivity. In the laboratory, they moved to the lighter side of a cage and were particularly excited by blue or ultra-violet light, but remained motionless in red light and in darkness. When groups of 10–33 females taken after feeding on man were confined in tubes, those exposed to sunlight died within 24 hours, those kept in daylight at an average temperature of 21°C. [69·8°F.], and in darkness at an average of 25°C. [77°F.], died within three days, while those kept in darkness at 21°C. did so within six days, probably because they were unable to oviposit; 12 females of *S. metallicum*, *S. ochraceum* and *S. callidum*, taken while attempting to bite, were found by dissection to have been already fertilised. When females of the same three species, taken before they had fed or before they had completed a

meal, were caged, they refused to feed on the arm of a boy, though he was readily attacked in the open. In another experiment, in which females that had fed in the afternoon were put into cages exposed to the sun and wind, all died within three hours, apparently through rupture of the stomach.

It is stated in the third paper that the absence during the rainy season in Chiapas (April–September) of adults of the Simuliids that attack man is attributable to the fact that the larvae are dislodged by the increased flow of water in the streams in which they breed, particularly if grit, leaves and twigs are carried along. When leaves bearing larvae of *S. metallicum* were removed from a stream, the larvae soon detached themselves and moved about in search of moisture; if the leaves were then returned to the stream, the larvae were easily swept away, and if they were exposed to sunlight the larvae died in 20 minutes; larvae of *S. virgatum* survived a little longer and did not detach themselves from the leaves if kept in shade. When the flow of streams containing larvae of *S. metallicum* and *S. callidum* was interrupted for two minutes and then allowed to continue, 75–85 per cent. of the larvae that had been exposed to the air and 40–60 per cent. of those that had remained submerged in pools were swept away; if the current carried sand or leaves down, 75–85 per cent. of the latter were removed. In 12 experiments in streams in which the water was dammed and released suddenly, the resulting flow swept away 70–100 per cent. of the larvae present for several dozen yards below the dam, as well as dead leaves, sand and gravel.

DELMANTO (A.). **Sôbre a miíase oftálmica. Tratamento de sua localização intra-orbitária.** [On ophthalmic Myiasis. Treatment of intra-orbital Infestation.]—*Publ. méd.* no. 155 pp. 17, 19–21, 23–24, 2 figs. São Paulo, 1945.

The author states that infants in country districts of Brazil, when put to sleep out of doors, are frequently infested by *Dermatobia hominis*, Say (*cyaniventris*, Macq.), particularly in the region of the eyes, and he describes the technique employed in the removal of a full-grown larva from the orbital cavity of a six-months old child.

SQUIBB (R. L.). **Studies on the Control of the Nuche Fly and Cattle Tick.**—*J. Anim. Sci.* **4** no. 3 pp. 291–296, 5 refs. Menasha, Wis., 1945. **A new Method for the Control of Cattle Ticks in Tropical Regions.**—*Op. cit.* **5** no. 1 pp. 71–79, 1 fig., 6 refs. 1946.

In the first paper, an account is given of preliminary experiments carried out in Costa Rica from September to December 1944 on the use of DDT and aqueous extracts of derris for the control of *Dermatobia hominis*, Say, and incidentally *Boophilus annulatus microplus*, Can., the most serious pests of cattle in Latin America. Infestation by *D. hominis* occurs principally at intermediate altitudes in countries bordering the Caribbean Sea. It renders hides useless for leather and often results in the death of the animal through cut arteries or secondary infection. The egg stage, larval periods before and after entering the skin of the animal, pupal stage and adult life last, respectively, 4–8, 1–3, 38–48, 70–72 and 7–9 days. An extract prepared by steeping 1 lb. crushed green derris root in 1 U.S. gal. water for 24 hours was applied to infested cattle by hand with a rag on 29th September. The numbers of larvae of *D. hominis* in the treated animals on 26th October and on 2nd November, after a week's continuous rain, represented 70 and 32 per cent. of the original number, and the numbers in untreated animals represented 135 and 75 per cent. The extract had little effect on the tick but showed healing properties. A 4 per cent. solution of DDT in kerosene applied weekly as a spray at 25 cc. per animal reduced the numbers of larvae of *D. hominis* by about half in two

months but did not hasten healing. Three treatments killed all ticks. Spraying with about 1 U.S. quart of the derris extract and then with 20 cc. of the DDT solution reduced infestation by *D. hominis* by nearly 84 per cent., and two treatments killed all ticks and had healing properties. Infestation among untreated animals increased by more than 55 per cent. In view of these results, a single spray solution was devised containing 1 gm. DDT powder, 14 cc. kerosene, the extract from 40 gm. chopped green derris roots, 6 gm. neutral soap and 400 cc. soft water. Applied at 400 cc. per animal as a fine spray, it gave excellent results against the fly and the tick. Kill of ticks was complete in 96 hours. As supplementary measures, it is recommended that shady areas in pastures should be reduced to a minimum and water holes kept open and free of weeds. Open-sided sheds should be provided for shade and protection and sprayed to control flies.

In the second paper, the author deals with the use of a combined spray of derris extract and DDT for the control of *B. a. microplus*, as dipping is in many ways unsuited to conditions in Costa Rica and is very unpopular. The derris roots from which the extracts were made had an average rotenone content of 5 per cent. (dry basis). Only cattle with more than two ticks per sq. inch were used in the experiments. The method of estimating the density of ticks on the animal is described. The spray adopted after many tests was composed of two solutions, the first containing 6·16 gm. DDT, 66·6 gm. kerosene, 33·3 cc. water and 1·8 gm. neutral soap, and the second containing the extract of 22·5 gm. green crushed derris root in 200 cc. water with 3 gm. neutral soap. The second solution was prepared immediately before use and the two were mixed in equal parts. Methods of preparation are given. In small-scale tests, the combined spray at 100 cc. per animal had killed 93 per cent. of the ticks after seven days, and the DDT and derris solutions separately at 50 cc. with the same amount of water had killed 85 and 35 per cent.

In field tests with the combined spray in a very wet lowland district, 36 heavily-infested oxen treated on 21st December 1944 were practically free of ticks 72 hours later and control averaged more than 92 per cent. after 96 hours. Reinfestation was beginning on 24th January 1945, and on 2nd March the population had reached approximately its original level on six animals and one-third of its original level on the others. The heavily reinfested cattle were resprayed with a mixture of two parts of the DDT solution to one part of the derris extract, but this increase in the amount of DDT did not seem to increase the effectiveness of the spray. In a dry lowland district, 94 per cent. mortality of ticks on very heavily infested cattle had occurred 120 hours after treatment with the combined spray. After 15 days, animals that had been freed of ticks by an arsenical dip were again heavily infested, whereas the sprayed animals had only 10 per cent. as many ticks as the dipped ones. In another test, a spray of one part of the DDT solution and two parts of the derris extract was less effective than the spray combined in equal proportions. Use of the combined spray on more than 1,000 animals over a period of six months failed to reveal any poisonous or prolonged irritant effects. Spraying the trousers with 20 cc. prevented infestation of workers. Spraying animals with 80–150 cc. per head every 14 days is recommended for a general eradication campaign. A fine penetrating spray was most efficient.

Papers noticed by Title Only.

Shanahan (G. J.). **"666"** [benzene hexachloride] **as a Contact Larvicide. Experiments with the primary Sheep Blowfly** (*Lucilia cuprina*).—*Agric. Gaz. N.S.W.* **57** pt. 10 p. 546, 1 ref. Sydney, 1946. [*Cf. R.A.E.*, B **35** 166.]

Cottam (C.) & Higgins (E.). **DDT : its Effect on Fish and Wildlife.**—*Circ. Fish Wildlife Serv.* no. 11, 14 pp., 13 refs. Washington, D.C., 1946. [*Cf. R.A.E.*, B **35** 88.]

Doty (R. E.). **Rat Control on Hawaiian Sugar Cane Plantations.**—*Hawaii. Plant. Rec.* **49** no. 2 pp. 71–239, 2 fldg. pls., 71 figs., 87 refs. Honolulu, 1945.

This paper includes a brief section on the diseases carried by rats in the Hawaiian islands, among which are plague and endemic typhus. Plague occurs only in one district of the island of Hawaii and one of the island of Maui [*cf. R.A.E.*, B **23** 156]. Recent work has shown that in addition to *Xenopsylla cheopis*, Roths., and *Nosopsyllus* (*Ceratophyllus*) *fasciatus*, Bosc, *Echidnophaga gallinacea*, Westw., can transmit endemic typhus fever [**30** 131]. Rats carrying several hundred individuals of *E. gallinacea* each [*cf.* **23** 157] have been caught in Honolulu, and this amply accounts for the prevalence of typhus fever there.

Bearup (A. J.) & Lawrence (J. J.). **A Search for the Vector of** *Plasmodium pteropi* **Breinl.**—*Proc. Linn. Soc. N. S. W.* **71** pt. 3–4 pp. 197–200, 7 refs. Sydney, 1947.

Plasmodium pteropi is common in flying foxes (*Pteropus*) in northern Queensland, and human malaria, mostly caused by *Plasmodium vivax* and transmitted by *Anopheles farauti*, Lav., also occurs in parts of the area. As the results of surveys of the extent of infection of Anophelines with human malaria might be inaccurate if these mosquitos could carry *P. pteropi* also, investigations were made on the vector of this *Plasmodium*. Various blood-sucking Diptera, including mosquitos of the genera *Aëdes* and *Culex*, taken near concentrations of three infected species of *Pteropus* were dissected with negative results, and 334 mosquitos including 125 females of *Anopheles punctulatus*, Dön., three of *A. farauti* and four of *A. annulipes*, Wlk., fed on infected individuals of *P. gouldi*, failed to show any evidence of infection on subsequent dissection. It is concluded that it is most improbable that Anophelines can act as invertebrate hosts for *Plasmodium pteropi* or that any mosquitos are important vectors.

Creac'h (P.). **Notes succintes sur** *Stegomyia fasciata* **en saison fraîche 1938-1939 à Fort-Lamy (Tchad).**—*Encycl. ent.* B II Dipt. **10** pp. 152–154. Paris, 1947.

Mosquito larvae are seldom found in domestic water containers at Fort-Lamy, Chad, because the water is not allowed to stand long and empty tins are not left about, as the metal is valuable. At the end of December 1938, when the minimum temperature was 15°C. [59°F.] and no rain had fallen for more than two months, numerous adults of *Aëdes aegypti*, L. (*Stegomyia fasciata*, F.) were taken in native huts and larvae of the same species in pools. All of 22 breeding places examined contained larvae of *A. aegypti* to the exclusion of other mosquitos. Investigation on 24th and 28th December and 4th, 12th and 20th January 1939 showed them to comprise small shallow pools 40–100 yards from dwellings and left when the level of the river fell, the edges of large ponds more than 150 yards from dwellings and holes near native wells. There was no vegetation round any of them. Apart from the river, all water, whether clear, muddy or putrid, contained larvae. On the same dates, larvae of *Anopheles* and *Culex*, but not of *Aëdes aegypti*, were found at places some miles from the town. Thus at Fort-Lamy, *A. aegypti*, finding none of its normal breeding sites in the dry season, oviposited in the only water available. Moreover, whereas it is usually held to be able to develop only at temperatures between 16 and 38°C. [60·8–100·4°F.], temperatures between 15th March and 15th May at Fort-Lamy regularly exceed 40°C. [104°F.] and the mean minimum temperatures for the last fortnight of December 1938 and the first fortnight of January 1939 were 15·8 and 13·5°C. [60·44 and 56·3°F.], respectively. The lowest

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minimum temperature recorded was 11°C. [51·8°F.] on 12th January. Small pools were oiled during the period, and larvae had practically disappeared by 20th January but adults were still numerous in huts.

SYNERHOLM (M. E.) & HARTZELL (A.). **Some Compounds containing the 3,4-methylenedioxyphenyl Group and their Toxicities toward Houseflies.**—*Contr. Boyce Thompson Inst.* **14** no. 2 pp. 79–89, 12 refs. Menasha, Wis., 1945.

Some naturally occurring substances containing the methylenedioxyphenyl group (particularly piperine, sesamin and fagaramid) have value in the control of houseflies [*Musca domestica*, L.]. The last two enhance the effectiveness of pyrethrum sprays [*R.A.E.*, B **31** 8, 99, 210–211, etc.], and piperine and several closely related amides and esters of piperic acid are also very toxic when used alone [**34** 61, etc.]. Reports are made in this paper on additional 3,4-methylenedioxyphenyl compounds that were synthesised and tested as fly-sprays against house-flies. The following is based on the authors' summary of the results. The condensation product (α-phenyl-β-piperonylacrylonitrile) between piperonal and benzyl cyanide was an effective synergistic agent with pyrethrins. Four substituted amides of α-phenyl-β-3,4-methylenedioxyphenylacrylic acid were prepared and found to be active when used with pyrethrins. The N-cyclohexyl amide and piperidide, the only ones tested without pyrethrins, showed a marked paralysing action of their own. Four new substituted amides of α-cyano-β-3,4-methylenedioxyphenylacrylic acid were synthesised and shown to be toxic to *M. domestica* when used with pyrethrins. When used alone, the piperidide appeared to have a moderate paralysing action. The N-cyclohexyl amides were the most toxic of the amides tested. The melting points and analyses are given of the piperidide and N-cyclohexyl amide of α-phenyl-β-3,4-methylenedioxyphenylacrylic acid, which have not previously been reported, and of the four amides of α-cyano-β-3,4-methylenedioxyphenylacrylic acid. The condensation products obtained from isosafrole and maleic esters were found effective against house-flies as synergists with pyrethrins or by their own paralytic action when used alone in oil (Deobase). The effectiveness of the crude reaction mixture obtained from tetrahydrofurfuryl maleate and isosafrole was at least as great as that of a product partly purified by petroleum-ether extraction. Piperonaldoximino-β-cyanoethyl ether was prepared and shown to be toxic to house-flies with and without pyrethrum.

BUSHLAND (R. C.). **Insecticides applied to Forest Litter to control New Guinea Chiggers.**—*J. econ. Ent.* **39** no. 3 pp. 344–347, 4 refs. Menasha, Wis., 1946.

The following is almost entirely based on the author's summary. Sprays consisting of 5 per cent. solutions of DDT, diphenylamine and diphenylene oxide in diesel oil and a dust of 5 per cent. DDT in calcium carbonate were applied to the surface of the forest litter in a rain-forest area near Hollandia in Netherlands New Guinea in small-scale tests on the control of Trombiculid larvae. Diphenylamine and diphenylene oxide had been shown to be very toxic to mites crawling on clothing impregnated with them. *Schöngastia pusilla*, Wom., and *S. blestowei*, Gunther, were about equally abundant in the area. Diesel oil alone at 40 U.S. gals. per acre caused a temporary cessation of mite activity, but some larvae were found crawling on the third day after treatment. Increasing the amount of oil applied to 80 and 160 U.S. gals. per acre did not appreciably improve control, and none of the three insecticides

added to the effectiveness of the oil. The dust at 320 lb. per acre reduced mite activity by about 80 per cent. for five days, but 8 and 12 days after treatment activity was again increasing.

It is concluded that DDT, diphenylamine and diphenylene oxide were of little value, but that frequent spraying with diesel oil might be practical as an adjunct to clearing for the control of Trombiculid larvae infesting camp sites in areas where tsutsugamushi disease (scrub typhus) occurs.

DEWS (S. C.) & MORRILL jr. (A. W.). **DDT for Insect Control at Army Installations in the Fourth Service Command.**—*J. econ. Ent.* **39** no. 3 pp. 347–355, 2 figs. Menasha, Wis., 1946.

The organisation of insect control at installations of the Fourth Service Command in the south-eastern United States from 1940 to 1944 is reviewed, and an account is given of the experimental use of DDT since 1944. In large-scale tests in the spring of 1945, DDT at 0·2–0·3 lb. per acre in 3–5 U.S. gals. diesel oil controlled mosquito larvae for about two weeks. In an experiment in Florida in 1944, 5 per cent. DDT in kerosene applied at 1 U.S. quart per 250 sq. ft. to the interior walls and other surfaces in screened barracks to leave a toxic residue gave protection from mosquitos near an area where *Aëdes taeniorhynchus*, Wied., was breeding extensively, and dispensed with the need for bed nets, which had previously been required and failed to give complete protection. This treatment was adopted as a routine measure in 1945 where control of larvae was impracticable.

Fumigation with hydrocyanic acid gas from HCN discoids and spraying with 5 per cent. thiocyanate in kerosene, 5 per cent. DDT in kerosene or 5 per cent. DDT as an emulsified solution were compared against bed-bugs [*Cimex*]. The sprays were applied at 1 U.S. quart per 10 units (beds or mattresses), and hand-operated pressure-tank sprayers were found to be more economical and to produce a more suitable spray than power sprayers. Except for one bite, DDT gave complete control in all cases, and re-treatment had not been found necessary more than a year later. The thiocyanate spray reduced infestation by 50–75 per cent. for a short time, and with this or fumigation, re-treatment was needed in 18 per cent. of the buildings after about seven months. The large-scale use of hydrocyanic acid gas for bed-bug control had been adopted late in 1943. Several thousand buildings were fumigated, and a dosage of 6 oz. HCN per 1,000 cu. ft. was found to give 100 per cent. kills with exposures of 8–12 hours.

Sprays containing 5 per cent. DDT, applied to leave a toxic residue in dairy barns and mess halls, and sprays and 10 per cent. dusts in garbage racks and latrines of different types gave 70–100 per cent. control of flies in all except one instance, and kept populations low for 4–6 weeks. In some closed latrines, the treatments were effective for three months. Thiocyanate space-type sprays were not satisfactory, but results were good when they contained 1 per cent. DDT and were directed heavily upon the walls. Spraying of the pit and the interior of the box in latrines was slightly more effective than spraying the screen and interior of buildings. DDT appeared not to be an effective larvicide for flies and was erratic in its effect on *Hermetia illucens*, L. In the case where reduction in population was not apparent, flies were coming from an unscreened dairy barn some 500 ft. away in which a commercial fly spray was being used.

Experiments with DDT dusts and sprays for the control of *Periplaneta americana*, L., and *Blattella germanica*, L. [*cf. R.A.E.*, B **34** 84] showed that complete coverage of all crevices was even more necessary than with sodium fluoride. The combined use of a 5 per cent. solution in kerosene and a 10 per cent. dust in pyrophyllite gave excellent results. An emulsion did not seem to be more effective, even with a higher percentage of DDT. Treatment for

flies and cockroaches is now combined, 3–4 U.S. gals. spray and 3 lb. dust being used per mess room 20 × 100 ft. in area. This with subsequent spot treatments [treatments of restricted favoured areas] with 10 per cent. dust and 1 per cent. spray suffices for most of the summer. Data are given on the relative costs of some of the methods discussed.

KARTMAN (L.) & DA SILVEIRA (M. M.). **Effect of short Contact with DDT Residues on** *Anopheles gambiae*.—*J. econ. Ent.* **39** no. 3 pp. 356–359, 2 figs., 2 refs. Menasha, Wis., 1946.

In laboratory experiments carried out in Senegal in 1944, large numbers of females of *Anopheles gambiae*, Giles, were exposed individually for 5, 30 or 60 seconds in an aspirator tube 8 ins. long and 1 cm. in diameter to a DDT deposit equivalent to 125 mg. DDT per sq. ft. (the dosage used under field conditions in native villages). Some showed tremors typical of DDT poisoning in less than 10 minutes, most did so within 30 minutes and all in 90 minutes. All females exposed for 60 seconds were dead 9 hours later. Among those exposed for 30 and 5 seconds, 97 and 74 per cent. were dead after 10 hours and 100 and 97 per cent. after 24 hours, respectively. Toxicity and mortality curves for the two groups with the longer periods of exposure were similar, and there was a general correlation between toxicity and mortality trends in all groups. Most females were not in a condition to feed 1–2 hours after the onset of tremors. The deposit in the tube was shown not to have lost toxicity after 55 days of use in these experiments.

KNIPLING (E. F.). **DDT to control Insects affecting Man.**—*J. econ. Ent.* **39** no. 3 pp. 360–366, 28 refs. Menasha, Wis., 1946.

This summary of knowledge on the use of DDT for the control of the more important insects affecting man includes data on types of DDT preparations ; the control of mosquito larvae with emulsified or unemulsified oil solutions ; DDT aerosols, space sprays, sprays to leave a toxic residue and outdoor sprays against adult mosquitos ; area control of adults and larvae from aircraft ; space sprays, aerosols and toxic deposits, particularly from suspensions, for controlling flies ; dusts and sprays against fleas and bed-bugs (*Cimex lectularius*, L., and *C. hemipterus*, F.) ; powders and impregnation of clothing against the body louse, *Pediculus humanus humanus*, L. (*P. h. corporis*, Deg.) ; and a powder and a liquid preparation against the head and crab lice, *P. h. capitis*, Deg. (*P. h. humanus*, auct.) and *Phthirus pubis*, L. Recommended dosages and concentrations are given in many cases. The liquid advocated against head and crab lice was developed by G. W. Eddy. It is prepared by mixing five parts water with one part of a concentrate known as the NBIN formula and consisting of 68 per cent. benzyl benzoate, 6 per cent. DDT, 12 per cent. benzocaine and 14 per cent. Tween 80 (a polyoxyethylene derivative of sorbitan monooleate). The benzyl benzoate serves as the solvent for the DDT and benzocaine and was chosen because it destroys the scabies mite [*Sarcoptes scabiei*, Deg.]. The preparation is effective against scabies when diluted as recommended for louse control. The Tween 80 is the emulsifier. Benzocaine kills louse eggs and also alleviates the irritation that usually accompanies louse infestation. A single treatment will destroy all lice and eggs and prevent reinfestation for about three weeks. The preparation has also been used as a body spray, in connection with fumigation of clothing with methyl bromide for controlling body lice [*R.A.E.*, B **32** 195], to destroy lice and eggs that sometimes attach to body hairs.

Bruce (W. G.) & Blakeslee (E. B.). **DDT to Control Insect Pests affecting Livestock.**—*J. econ. Ent.* **39** no. 3 pp. 367–374, 1 fig. Menasha, Wis., 1946.

The following is based on the authors' summary of this account of experiments made in 1944 and 1945 on the effectiveness of DDT for the control of various Arthropod pests of livestock (mostly cattle) in the south-eastern United States. A serious outbreak of *Stomoxys calcitrans*, L., in central Florida in 1944 was controlled by passing cattle through a wading vat containing 2 per cent. DDT in the form of an emulsified solution and spraying their backs and the resting places of the flies with the same emulsion. In tests in South Carolina and Florida in 1945, two applications to cattle in April and May at 1 and ½ U.S. pint per animal, respectively, of 2·5 per cent. DDT as an emulsified solution reduced very large populations of *Siphona irritans*, L., to well below nuisance numbers for the rest of the season. Dipping the cattle in an emulsion containing 0·2 per cent. DDT was less effective than spraying with one containing 2 per cent. One application to the interior of dairy buildings of a spray containing 2·5 per cent. DDT, either as an emulsified solution or a water suspension, controlled *Musca domestica*, L., for the whole season, if the interior was ceiled and painted and fly sanitation was good.

For large-scale tests made in Florida in 1945, water suspensions only were used as the DDT applied in this form cannot be absorbed through the skin and is much safer for domestic animals. Some 26,000 head of livestock and 120 dairy buildings were treated with suspensions prepared in various strengths from water-dispersible DDT powder. *S. irritans* was the chief pest of cattle and horses, and fresh-water mosquitos, mainly *Culex fatigans*, Wied. (*quinquefasciatus*, auct.), *C. nigripalpus*, Theo., *Psorophora confinnis*, Lynch, and *P. ciliata*, F., were very abundant and annoying to man and animals in some areas. Dipping cattle in a suspension containing 0·23 per cent. DDT gave complete control of *S. irritans* for 10–14 days. There was no apparent effect on other pests with the possible exception of cattle lice. Complete control of *S. irritans* was obtained for 2–3 weeks by spraying with a 0·5 per cent. suspension of DDT, which also reduced the numbers of fresh-water mosquitos for about three weeks and was effective for some time (not exceeding a month) against *M. domestica* in dairy buildings. The control of all insects obtained with a suspension containing 1 per cent. DDT was about the same as that obtained with the suspension containing 0·5 per cent. One containing 2·3 per cent. gave complete control of *S. irritans* for 4–7 weeks, and was effective against *M. domestica* for more than three months when sprayed on barns and for more than three weeks in pig pens. It was very effective against *Stomoxys calcitrans* when applied to stock and to the resting places of the flies, gave complete control of fresh-water mosquitos when applied as a spray to livestock and buildings, and was effective against cockroaches in barns. Thoroughly applied, it was apparently effective against lice on cattle and goats. It reduced the adult population of *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.) and was effective against *Amblyomma maculatum*, Koch. There was no apparent sign of injury to the animals as a result of the application of the DDT suspension. It is estimated that the sprays were responsible for a gain of at least 700,000 lb. beef and 30,000 U.S. gals. milk, during the month following application.

Smith (C. N.) & Gouck (H. K.). **Observations on Tick Repellents.**—*J. econ. Ent.* **39** no. 3 pp. 374–378. Menasha, Wis., 1946.

An account is given of experiments in Georgia and field tests at Camp Bullis, Texas, on the effectiveness of various repellents against ticks, mainly nymphs and adults of *Amblyomma americanum*, L. They were applied to the clothing only, as they had been found to give better results in this way than when applied

to the skin. The following is mainly based on the authors' summary of the results. In the experiments in Georgia, a moderately high degree of protection was obtained with Indalone [n-butyl mesityl oxide oxalate], here defined as α,α-dimethyl-α′-carbobutoxy-γ-dihydropyrone, and with dimethyl phthalate; benzyl benzoate, dixanthogen (bisethylxanthogen) and pyrethrum were also of some value. DDT had no effect in pyrophyllite and very little in kerosene, and in benzyl benzoate and dimethyl phthalate it was no more repellent than the solvent alone. In the field tests in Texas on troops exposed to light infestations, Indalone, dimethyl phthalate and a rotenone-sulphur dust reduced attachments for a few days. When used in the field by troops exposed to heavy infestations, both dimethyl phthalate and 6-2-2 (six parts dimethyl phthalate, two parts Indalone and two parts 2-ethyl-1,3-hexanediol by volume) [*R.A.E.*, B **34** 10] substantially reduced attachments when applied to the margins of the clothing. Reductions were greater when the clothing was re-treated after three days than when only one treatment in five days was given, and were slightly greater when the whole garments were sprayed than when the margins were treated from a bottle.

Sweetman (H. L.). **DDT as a Spot Treatment for Flies.**—*J. econ. Ent.* **39** no. 3 pp. 380–381, 13 refs. Menasha, Wis., 1946.

Tests in Massachusetts have shown that under local conditions, DDT sprays for the control of flies need not be applied indiscriminately over extensive areas but only to favoured resting places. A solution of 5 per cent. DDT in odourless kerosene applied in this way gave adequate control in houses and did not leave an objectionable deposit. A 25 per cent. solution left such a deposit on some surfaces but was more effective. Concentrations of 20–25 per cent. DDT, either in oil solutions or as a water-miscible product, were desirable for milking-sheds. The sprays may be applied at any time of day, but preferably not while milking is in progress. Fly populations in a milking shed and milk room remained consistently low when a few selected areas totalling about 80 sq. ft. were sprayed with a 25 per cent. solution of DDT in oil at intervals of 3–10 days beginning in late August when both house-flies [*Musca domestica*, L.] and stable flies [*Stomoxys calcitrans*, L.] were numerous. The manure pile near the building was not removed or treated. Ten minutes was the longest time taken in applying spray in any one week, and less than one U.S. gal. spray was used throughout the season. An application was made whenever an increase in the numbers of flies was observed, as a heavy population rendered the spray residue ineffective in 3–5 days.

Several insecticides, including DDT, had failed to prevent fly breeding in manure at a piggery where populations were large in 1944, especially around the troughs and automatic feeders. A system of rotation of the feeding equipment in the field at intervals of about five days in 1945 prevented accumulation and packing of the manure that could serve as a breeding medium. Electric screens on the piggery windows controlled the flies fairly well early in the season, but DDT was needed in August and September. A 25 per cent. spray applied to selected areas about the buildings kept the population low.

Snyder (F. M.) & Morton (F. A.). **Materials as effective as Benzyl Benzoate for impregnating Clothing against Chiggers.**—*J. econ. Ent.* **39** no. 3 pp. 385–387, 2 refs. Menasha, Wis., 1946.

In 1944, Morton developed methods of impregnating clothing with dimethyl phthalate combined with miscible emulsifiers for protection against Trombiculid larvae, and after extensive tests in New Guinea it was recommended that soldiers should dip their whole uniforms in an emulsion containing 5 per cent. dimethyl phthalate and 2 per cent. soap [*R.A.E.*, B **34** 147; *cf.* also **34**

169–170]. Snyder & Morton showed that, under field conditions in Florida, benzyl benzoate was as effective when freshly applied as dimethyl phthalate or dibutyl phthalate in preventing attachments by larvae and was more effective than either when the treated clothing was washed by several methods [*cf.* **34** 170]. Benzyl benzoate afforded complete protection even after clothing had been washed twice and a high degree of protection after it had been washed three times. Further work was then undertaken to find materials more effective than benzyl benzoate and readily available in large quantities, and the best were tested in the field. The results are given of the field tests on nine materials that were found to be equal to benzyl benzoate or better. The materials were used in acetone or xylene solutions or emulsions with Tween 80 [**35** 188] as the emulsifier to impregnate cotton twill uniforms and woollen socks at 2 gm. per sq. ft. (about 8 per cent. by weight of cloth). Research subjects sat or lay on the ground wearing the treated clothing for one hour in a heavily infested area, and removed the uniforms after an additional two or three hours. The numbers of mites actually attached to the subjects were counted. Benzil afforded almost complete protection for three more washings and phenyl benzoate for two more washings than benzyl benzoate, which was tested concurrently. All the remaining materials were as effective as benzyl benzoate and gave a higher percentage of protection after the third wash. Benzil is being produced commercially. It is considered, however, that sufficient tests have not yet been made to justify definite recommendation of any of the nine materials.

Miles (V. I.) & Rings (R. W.). **Distribution Records for Mosquitoes of the southeastern States in 1945.**—*J. econ. Ent.* **39** no. 3 pp. 387–391, 10 refs. Menasha, Wis., 1946.

During 1945, 400,833 mosquitos taken at 127 army installations in Tennessee, Mississippi, Alabama, North and South Carolina, Georgia and Florida were specifically identified [*cf. R.A.E.*, B **32** 77, 194; **34** 166; **35** 93], and the six new state records and 106 additional locality records made are here given, the date and method of collection and number of individuals taken being shown. The new records involve species of seven genera. New inland records of *Anopheles crucians bradleyi*, King, indicated that this saltwater mosquito [**34** 187] has a comparatively long flight range. Larvae of *A. c. georgianus*, King, were taken in coastal localities where *A. c. bradleyi* is commonly collected.

Randolph (N. M.). **DDT to control the Relapsing Fever Tick.**—*J. econ. Ent.* **39** no. 3 p. 396. Menasha, Wis., 1946.

Sprays prepared by diluting a stock emulsion or a stock solution containing an emulsifier to give 1-20 per cent. DDT were tested against *Ornithodoros turicata*, Dugès, in 1944. They were applied directly to the ticks before these were placed in cages or to clay in the cages before the admission of the ticks or to pieces of cheese-cloth three inches square. About 5 cc. was used for each group of ten ticks. Sprays containing 10 and 20 per cent. DDT applied to cheese-cloth gave complete kill in 30 days and one day, respectively. Sprays containing 10 per cent. DDT applied directly to the ticks gave 80 and 90 per cent. kills in 35 days in two tests. Concentrations of 1 and 5 per cent. never gave more than 20 and 70 per cent. kill, respectively, in 35 days. It is concluded that DDT at high concentrations shows promise for the control of *O. turicata* but the cost and practicability of applying it under natural conditions may be limiting factors.

Brett (C. H.) & Fenton (F. A.). **DDT as a residual Insecticide for Fly Control in Barns.**—*J. econ. Ent.* **39** no. 3 pp. 397–398. Menasha, Wis., 1946.

Tests were made in 1945 to determine the effectiveness of DDT deposits for the control of flies in brick-built, concrete-floored farm buildings in Oklahoma.

Kerosene and water-base sprays and a dust of 10 per cent. DDT in pyrophyllite were used. The active fly population was measured by means of bait cards painted with a solution of one part molasses in two parts vinegar and exposed in favoured resting places of the flies. Sprays containing various percentages of DDT were applied at 1 U.S. gal. per 1,000 sq. ft. on various dates, and the dust at 1 lb. per 1,000 sq. ft. on 31st July and 6th September. The duration and effectiveness of control was found to increase with increase in concentration of DDT and decrease of temperature. A 0·2 per cent. spray was of little value. When applied on 31st July, a 3 per cent. water spray gave excellent control for about four weeks, a 2·5 per cent. spray lasted as long but was less effective and the dust gave good control for about a week. A 5 per cent. spray applied early in September practically eliminated flies for the rest of the season, but the dust at this time was less effective. It is recommended that the initial spray should contain 5 per cent. DDT and the second, applied 6–8 weeks later, 2·5–3 per cent. The control of the flies in treated buildings caused their practical disappearance from untreated buildings nearby.

Gouck (H. K.). **DDT to control Rat Fleas.**—*J. econ. Ent.* **39** no. 3 pp. 410–411. Menasha, Wis., 1946.

Preliminary studies were made in Georgia in 1944–45 to determine the effect of DDT in reducing populations of rat fleas in buildings. The fleas observed were *Xenopsylla cheopis*, Roths., *Leptopsylla segnis*, Schönh., *Nosopsyllus fasciatus*, Bosc, and *Echidnophaga gallinacea*, Westw., and all rats taken were *Mus* (*Rattus*) *norvegicus*. The fleas from rats treated with 10 per cent. DDT dust in the laboratory became paralysed and died. The treatment of rat holes and basement floors with 10 per cent. DDT dust was followed by a sharp reduction in infestations of rat fleas in buildings. A method was developed of suspending cheese-cloth bags of DDT dust along the top of the inside of cylinders designed to be placed at the entrances of rat holes and in frequented runways so that rats passing through rub against the bag and receive a sprinkling of the dust. In two of three laboratory tests of cylinders charged with a dust of 10 per cent. DDT in pyrophyllite, the fleas on the rats, which included all the four species, were definitely affected by the DDT as they dropped from the host within three hours of treatment and were paralysed at the time of dropping. They died within 48 hours. Fleas on control rats were normally active. In the third test, fleas dropped from one to 48 hours after treatment from both the treated and untreated rats and were dead 48 hours after dropping. The fleas from the treated rat appeared paralysed when collected, but those from the untreated rat were active.

Numbers of rat fleas were greatly reduced in two poultry stores at Savannah after rat holes and basement floors had been dusted with 10 per cent. DDT in pyrophyllite. Charged cylinders each containing 25 gm. dust used in a poultry store and a grain store are stated to have been slightly less effective than general dusting, but they are safer for such places as grain stores.

Telford (H. S.) & Guthrie (J. E.). **Effects of oral Dosages of DDT on certain Vertebrates.**—*J. econ. Ent.* **39** no. 3 pp. 413–414, 2 refs. Menasha, Wis., 1946.

DDT administered by stomach tube to goats at 1·5–3·3 gm. per kg. body weight caused mild to severe tremors from which the animals recovered, with the exception of one goat in poor condition at the outset, which became prostrate in 52 hours and was destroyed. A goat that received 5·5 gm. per kg. could not rise by the 13th day and was destroyed and one receiving 6·5 gm. died on the 16th day. A horse to which 0·26 gm. per kg. was administered in feed, and fowls to which 0·35–0·49 gm. per kg. were administered in gelatin capsules, showed no symptoms. Five lactating goats that received 0·25–0·28 gm. solid

DDT per kg. body weight by stomach tube or in feed daily for 21–29 days all lost weight, and their output of milk declined considerably. Three showed light to moderate tremors and the others no symptoms, and all recovered. DDT was found to be present in the milk of these goats. No symptoms developed in a lactating goat weighing 50 kg. and given 1 gm. solid DDT in its feed daily for 2½ months, nor did any develop in the kid that the goat suckled during the experimental period. Feeding on milk, butter and cream from this goat produced no signs of poisoning in white rats. In an experiment in which five young fowls were fed on mash containing 0·1 per cent. DDT and five others on mash containing 0·1 per cent. DDD (dichlordiphenyldichlorethane), all the former died in 3–10 days showing typical signs of DDT poisoning, whereas of the latter, one died on the 19th day and one on the 29th, both without signs of poisoning before death, and three lived for about two months on the DDD diet, apparently without harmful results.

SWEETMAN (H. L.). **DDT to control Cat and Dog Fleas and Dog Lice.**—*J. econ. Ent.* **39** no. 3 pp. 417–418, 4 refs. Menasha, Wis., 1946.

Fleas, especially *Ctenocephalides felis*, Bch., were common on cats and dogs and in houses in Massachusetts during 1945. Dogs and cats are the usual source of infestations in houses. However, none was known to have entered one infested house for some months, and this was the only house of a number treated that became reinfested during the season. About 20 infested houses were treated with a 10 per cent. DDT powder during 1945 and a few with a 5 per cent. powder. Excellent results were obtained. A very light (barely visible) application of the dust was made to the floors and rugs, generally on all storeys and the basement, and the sleeping places of the infested animals, indoors or outside, and any upholstered furniture used by the animals were also treated.

Fleas were also exterminated on 20 cats and nine dogs that received the 10 per cent. powder. The cat or dog should be treated at the same time as the house or shortly after, by applying the dust from a shaker along the back and lightly working it into the hair. Fleas became more active on treated animals, and irritation increased accordingly. This made the animals more active, and, in houses that had not already been treated, the increased activity of the animals made more fleas jump on to them so that they were distressed still more. Irritation ceased soon after the animals were taken out or the floors treated, and no cat or dog showed any sign of being harmed by the DDT. A single treatment of floors and animals rid both of fleas when dusted at the same time, and one dog was freed of lice by three treatments with 10 per cent. powder applied to the infested parts only. Regular cleaning of a room should be discontinued for three or four days after dust has been applied.

RANDOLPH (N. M.). **DDT for the Control of** *Triatoma*.—*J. econ. Ent.* **39** no. 3 p. 419. Menasha, Wis., 1946.

In cage tests of the toxicity of DDT to adults of *Triatoma lecticularius occulta*, Neiva, one of several members of the genus that occur in Texas, sprays containing emulsified solutions of DDT killed all the bugs in 3–8 days. Speed of kill was not proportional to the concentration of DDT, which ranged from 1 to 5 per cent. The emulsions were applied to ten bugs in each test, and the bugs were kept in the sprayed cages throughout the experiments.

EADS (R. B.). **A new Record of** *Anopheles albimanus* **in Texas.**—*J. econ. Ent.* **39** no. 3 p. 420, 2 refs. Menasha, Wis., 1946.

Five females of *Anopheles albimanus*, Wied., which has previously been established in the United States only in the lower Rio Grande Valley in Texas [*cf. R.A.E.*, B **26** 112, 216; **34** 141], were taken in light-traps in November

1945 in three places in the Corpus Christi area. Since 1937, the species has been found in large numbers in the Brownsville area during all but the coldest winter months, but this is the first time that it is known to have migrated from the Rio Grande Valley to other parts of Texas. A preliminary survey revealed no larvae, but before a careful search could be made the whole area was sprayed with a 5 per cent. solution of DDT from an aircraft, and numbers of mosquito adults and larvae were drastically reduced.

LINDQUIST (A. W.), MADDEN (A. H.) & SCHROEDER (H. O.). **Effect of Temperature on Knock-down and Kill of Mosquitoes and Bedbugs exposed to DDT.**—*J. Kans. ent. Soc.* **19** no. 1 pp. 13–15, 1 ref. Manhattan, Kans., 1946.

Experiments on the effect of temperature on the toxicity of DDT to mosquitos and bed-bugs (*Cimex*) were made by the technique previously employed for *Musca domestica*, L. [*R.A.E.*, B **34** 134]. For the tests with mosquitos, wire-gauze cages were treated with DDT at 200 mg. per sq. ft., and for *Cimex*, glass jars were sprayed at 100 mg. per sq. ft. The times required for complete knock-down of some 500 individuals of *Anopheles quadrimaculatus*, Say, exposed continuously at 70, 80, 90 and 100°F. in cages treated 3–4 weeks earlier were 140, 138, 116 and 28 minutes, respectively. Hardly any of the mosquitos recovered after being knocked down. Percentages of knock-down after six hours and, in brackets, kill in 24 hours among adults of *A. quadrimaculatus* exposed for 15 minutes in a cage treated 30–40 days previously and then kept in clean cages at 70, 80 and 90°F. were 11 (20), 7 (15) and 4 (11) when the exposure temperature was 70° and 81 (86), 44 (46) and 25 (34) when it was 95°. Corresponding figures for *Culex fatigans*, Wied. (*quinquefasciatus*, auct.) exposed at 70 or 90°F. and subsequently treated like the Anophelines were 13 (14), 16 (10), 13 (8), 34 (59), 14 (15) and 17 (18). Knock-down among mosquitos of both species exposed at the higher temperatures was often higher after one hour than after six. When bed-bugs were exposed for five minutes at 70°F. in a glass jar sprayed 20 days previously and then kept in clean jars at 70, 80 or 90°F., *Cimex hemipterus*, F., was considerably more resistant than *C. lectularius*, L., kills in 48 hours at 70, 80 and 90°F. being 50, 40 and 38 per cent. for the former and 83, 64 and 63 per cent. for the latter.

DEONIER (C. C.). **Population Studies on *Cochliomyia americana* in Arizona.**—*J. Kans. ent. Soc.* **19** no. 1 pp. 26–29, 2 refs. Manhattan, Kans., 1946.

An account is given of studies made in southern Arizona in 1938 on the relationship between various environmental factors and the population of *Cochliomyia hominivorax*, Coq. (*americana*, Cush. & Patt.). Three metal cone-type traps baited with liver and water were used, three miles apart, in each of five areas. The situations in which the various traps were placed are described, with notes on the availability of hosts (sheep and cattle), and the numbers of females taken in each trap on various days are shown in a table. The season was very dry and conditions were generally unfavourable for a high population of *C. hominivorax*, though all available wounds became infested. Adults were found to be uniformly distributed over relatively small areas only when ecological conditions were uniform. Extremely high temperatures were shown not to prevent an increase in the population if moisture conditions were favourable. The presence of a larger population in the immediate neighbourhood of the host was indicated. During hot dry weather, the flies in the range sections were restricted to the neighbourhood of streams and mesquite draws where shade and moisture were available. There were signs of some movement of population to favourable areas.

Benbrook (E. A.). **List of Parasites of domesticated Animals in North America.** —Revd. edn., $10\frac{1}{2}\times8\frac{1}{2}$ ins., [1+]iii+53 pp. multigraph. Minneapolis, Minn., Burgess Publ. Co., 1946. Price $1.25.

This monograph consists of a list of the parasites (including blood-sucking Diptera as well as Arthropod parasites) that attack domestic animals in America north of Mexico, arranged according to the systems of organs in which they occur. Each entry consists of the scientific and popular names of the parasite or group, its systematic position, the site of the principal lesions and sometimes the organs or tissues through which it may pass during a disease-producing phase of its life-cycle, its host and its maximum length.

Mendy (R. M.). **El gusano del estómago de los yeguarizos o gastrofilosis equina.** [The Horse Bot-fly.]—*Alm. Minist. Agric. Argent.* **20** pp. 257–262, 10 figs. Buenos Aires, 1945.

Infestation of horses by *Gastrophilus nasalis*, L., is very common throughout Argentina. Notes are given on the life-history of the fly, the symptoms caused, and control by the administration of carbon bisulphide or carbon tetrachloride.

Casós (G. A.). **" Sinusitis parasitaria " y " cenurosis cerebral " de los ovinos.** [Parasitic Sinusitis and Cerebral Coenurosis in Sheep.]—*Alm. Minist. Agric. Argent.* **20** pp. 273–278, 2 figs. Buenos Aires, 1945.

Infestations of the head cavities of sheep by larvae of *Oestrus ovis*, L. [*cf. R.A.E.*, B **30** 66] and of the brain by larvae of the tapeworm, *Multiceps multiceps* (*Taenia coenurus*), are fairly common in Argentina, and since they are sometimes confused, accounts are given of the symptoms, development and treatment of the two affections.

Shanahan (G. J.). **The Control of Sheep Ked** (*Melophagus ovinus*). **Experiments with D.D.T. and " 666 " used in a Power Spray Unit.**—*Agric. Gaz. N.S.W.* **57** pt. 12 pp. 632–635, 2 figs., 1 ref. Sydney, 1946.

As the treatments generally used on sheep for the control of *Melophagus ovinus*, L., do not kill all the pupae or remain effective long enough to kill all adult keds that emerge from them (which they usually do within 22 days of deposition), the effect of using DDT or benzene hexachloride was studied in the Murrurundi district of New South Wales. Emulsions containing one or other of these insecticides were applied for six minutes with a power spray unit fitted with a $2\frac{1}{2}$-inch centrifugal pump delivering 170 gals. per minute to freshly shorn sheep in pens each containing a group of about 80. The spray was drawn from a sump with a capacity of 600 gals. Three sheep retained a gallon of fluid. The percentages of active ingredient in the sprays were 0·025, 0·05 and 0·075 p,p′ DDT and 0·01 γ isomer of benzene hexachloride, and two, three or four groups received a given treatment. Six marked sheep from each group were examined one, two and 28 days after spraying. The day after treatment, each marked sheep was carrying dead keds. The greatest numbers of live keds on any batch of six sheep, one, two and 28 days after spraying, were 4, 3 and 1 for 0·025 per cent. p,p′DDT, 2, 1 and 0 for 0·05 per cent., 17, 7 and 0 for 0·075 per cent., and 33, 20 and 3 for benzene hexachloride. However, the last series of figures was for the fourth batch treated. The earlier batches treated with benzene hexachloride had only 1–6, 0–3 and 0 keds, at the three examinations. The p,p′ isomer content of DDT sprays returning to the sump fell during use in all groups. The surviving keds were in the long wool of the neck and brisket that had not been thoroughly wetted. As all marked sheep were together from the third day after spraying, counts on these sheep may not provide a reliable guide to the relative effectiveness of the four treatments. Examination

of 20 per cent. of the sheep of the main groups 28 days after spraying showed two live adults and several well-advanced pupae in the long wool under the neck in a lot containing sheep that had received the two weaker DDT sprays, no live adults and one live pupa in the lot that had received the strongest DDT spray and two adults and several pupae in the lot sprayed with benzene hexachloride. These three lots had been kept separate throughout. There were young recently dead adults in all cases. It is concluded that the wool remained toxic for 28 days.

Schechter (M. S.), Soloway (S. B.), Hayes (R. A.) & Haller (H. L.). **Colorimetric Determination of DDT. Color Test for related Compounds.**—*Industr. Engng Chem.* (Anal. Edn.) **17** pp. 704–709, 5 figs., 28 refs. Easton, Pa., 1945.

The following is partly based on the authors' summary. A colorimetric method, involving intensive nitration and the production of colours by the nitrated products in benzene with methanolic sodium methylate, is described for the estimation of small amounts of DDT (down to about ten micrograms). It can also be used to distinguish related compounds and degradation products such as dehydrochlorinated DDT, but in the case of technical DDT, if there is considerable decomposition, it might be difficult to interpret the results because of the complexity of the system. Care should also be taken when aromatic halogen compounds that might interfere are known to be present ; however, such materials are unlikely to be present in spray residues.

Goodhue (L. D.) & Ballinger (W. R.). **Accelerated Aging Test for insecticidal Aerosols containing DDT.**—*Industr. Engng Chem.* (Anal. Edn.) **18** pp. 131–132, 1 fig., 4 refs. Easton, Pa., 1946.

The following is based on the authors' summary and the results of their tests. The introduction of DDT into the liquefied-gas aerosol has created the problem of stabilising the aerosol solution and preventing corrosion of the container. The ease with which hydrochloric acid is liberated from DDT in the presence of some iron salts has made necessary the development of an accelerated ageing test for studying the effect of the different aerosol constituents on this reaction. A simple pressure test tube and a method of running a test are described. The rate of decomposition varies greatly, depending mostly on the solvents used. Some of the combinations developed seemed to be satisfactory. A mixture of pyrethrum extract (20 per cent.), DDT, APS-202 (alkylated naphthalenes from petroleum) and Freon-12 (dichlordifluoromethane) was handled most easily and gave very good results ; various proportions were tested and none broke down in less than 50 days and some have kept unchanged for more than 100 days. A mixture containing isophorone and lubricating oil (no. 30) instead of the alkylated naphthalenes was fairly stable, causing tar formation in 52 days, and the addition of 0·03 per cent. dioleyl malate to one of pyrethrum extract, DDT, cyclohexanone, lubricating oil and Freon-12 appeared to give added stability in some cases. Propylene oxide is an excellent solvent for DDT and a stabiliser, apparently owing to its ability to accept nascent hydrochloric acid, but is highly inflammable and slightly toxic. A mixture of pyrethrum extract, DDT, APS-202, propylene oxide and Freon-12 (2 : 3 : 7 : 5 : 83) appeared to give the most stable DDT aerosol solution, no corrosion or tar formation occurring in tests running as long as 150 days ; this mixture was not inflammable. Freon-12 seemed to give a more stable solution than methyl chloride.

Fleck (E. E.) & Haller (H. L.). **Solubility of DDT in Kerosenes. Effect of auxiliary Solvents at subzero Temperatures.**—*Industr. Engng Chem.* **38** pp. 177–178, 4 refs. Easton, Pa., 1946.

The following is based on the authors' summary. The solubilities of technical and pure DDT in a number of kerosenes at temperatures ranging from −30 to 30°C. [−22 to 86°F.] were determined. It was found that kerosenes obtained from naphthenic-base crude oils dissolve more DDT than those obtained from paraffinic-base crude oils, the power of dissolving DDT generally increasing as the aniline point falls. The addition of petroleum fractions rich in alkylated naphthalenes retards the crystallisation of DDT from kerosene solutions kept at −30°C.

Fleck (E. E.) & Haller (H. L.). **Stability of DDT and related Compounds.**—*J. Amer. chem. Soc.* **68** p. 142, 5 refs. Easton, Pa., 1946.

The authors consider that the apparently lower stability of DDT in the pure form than in the technical grade is due to the loss of impurities such as polymers of chloral and 2-trichlor-1-p-chlorphenylethanol that inhibit the action of catalytic agents in the latter. They describe experiments that indicate how readily small traces of catalytic material may be picked up in the course of air-drying and handling with iron or stainless-steel equipment and how this may lead to the assumption that DDT is not so stable in the pure form as in the crude state.

Tolunay (M.). **Eine neue wirksame Anwendungsmethode des Globols (Dichlorbenzol) gegen Insekten und Kleintiere.** [A new and effective Method of using Globol (Dichlorbenzene) against Insects and small Animals.]—*Zbl. ges. Forstw.* **68** pt. 4 pp. 91–92, 1 fig. Vienna [1942].

When Globol ([para]dichlorbenzene) was vaporised in 8–10 times its volume of boiling water over a small stove in a fumigation chamber at a rate of 1 oz. per 100 cu. ft. in experiments in Turkey, it gave about 90 per cent. mortality of *Cimex lectularius*, L., *Blatta orientalis*, L., ants and grain weevils within 12 hours; the surviving insects were removed from the chambers, and all were dead after a further 12 hours. Higher concentrations gave more rapid mortality. In a test in which laboratory animals were similarly exposed to 2·5 oz. Globol, all showed distress for an hour and then died. It is concluded that Globol, vaporised in this way at a rate of 1 oz. per 100 cu. ft., will kill all the insects and small mammals in a closed room in 12 or at most 24 hours. Naphthalene can also be used in this manner but requires almost 20 times the quantity of water.

Steiner (G.). **Eine Zuchtweise für Fleischfliegen.** [A Method of breeding Blowflies.]—*Zool. Anz.* **138** pt. 5–6 pp. 97–106, 3 figs., 27 refs. Leipzig, 1942.

In view of the need for large numbers of larvae, pupae and adults of blowflies for experimental purposes, the author describes a method of mass-breeding in the laboratory that has given satisfactory results in Germany for more than three years. The adults are kept in wooden boxes usually measuring about 13 × 9 × 7 ins.; illuminated and heated from within by means of a 15–25 watt electric light bulb; there is a ventilation hole in the removable roof, and the whole of the inside is covered with absorbant paper or lime. The flies are fed on raw minced meat, on which the females deposit their eggs or larvae, and water and sugar are also provided; the water serves to keep the humidity high. The larvae are reared on minced beef in wide-necked flasks containing cellulose

wadding to absorb excess moisture; they pupate in the flasks. If necessary they can be made to pupate in dishes by sifting them from the flask contents on to absorbent paper and inducing them to crawl over the paper, which cleans them, to the dish by exposure to light.

A table is given showing the numbers of eggs laid by *Phormia regina*, Mg., *Lucilia caesar*, L., and *Calliphora erythrocephala*, Mg., and the quantity of meat required for the larvae per mg. of eggs. *Phormia* is the most easily reared in this way. Up to 500 adults can be kept in boxes of the above dimensions, and breeding is rapid since the larvae can withstand temperatures of up to 35°C. [95°F.] without excessive mortality, though a temperature of about 30°C. [86°F.] is more suitable for them. The eggs are laid in masses of 300–350. *Lucilia* is more difficult to rear, since it does not pair so readily in captivity, and fewer eggs are laid, many of which are sterile. The wings of the adults of both species are liable to break off when humidity is too low; for this reason and also because of their greater activity, adults of *Lucilia* should be kept in somewhat larger boxes and in adequate humidity. *Calliphora*, which the author has found inferior to *Phormia* for experimental purposes, should be kept at temperatures averaging 22–25°C. [71·6–77°F.]; larval and pupal mortality is high at 30°C. The small boxes are adequate for adults of *Sarcophaga carnaria*, L., although larger ones are more suitable, but only 10–15 larvae are produced per female; the wings are liable to break off, but this has little effect on pairing and reproduction in this species.

The method has also proved suitable for breeding other flies, and larvae of *Musca* [*domestica*, L.] can be reared on the remains of the meat in the flasks after the blowfly larvae have completed their development, thus rendering manure unnecessary.

STEINER (G.). **Methodische Untersuchungen über die Geruchsorientierung von Fleischfliegen.** [Methodical Investigations on the olfactory Orientation of Blowflies.]—*Z. vergl. Physiol.* **30** pt. 1 pp. 1–38, 34 figs., 38 refs. Berlin, 1942. **Zur quantitativen Analyse tierischer Geruchsreaktionen.** [The quantitative Analysis of the olfactory Reactions of Animals.]—*Naturwissenschaften* **30** pt. 41–42 pp. 647–648, 1 graph, 4 refs. Berlin, 1942.

The first of these two papers contains a detailed account of laboratory experiments designed to assess the reactions of blowflies to various odorous substances. They involved the use of wooden cages similar in principle to those used for mass-breeding [see preceding abstract], though somewhat longer, and illuminated by five lamps, in which inbred males and females of *Phormia regina*, Mg., reared under identical conditions were offered various odorous substances in glass bait-traps; equal numbers of traps containing water or saline of the same vapour pressure as the odorous substances were also provided, and counts were subsequently made of the numbers trapped. Preliminary tests having shown that slightly decomposed beef emitted highly attractive odours while meat in a more advanced state of decomposition did not, the baits tested included the amines that are present in decomposing protein. The degree of attractiveness of each bait was expressed as the ratio between the numbers of flies in the traps containing it and in the controls. It was found that at concentrations of 0·1–0·2 per cent., the methyl, trimethyl, diethyl and triethyl amines were repellent, and the dimethyl and ethyl amines attractive, while ammonia at 0·08 per cent. was repellent, but further tests indicated that the comparative effects of the amines may vary with the concentration. The absolute attractiveness of the baits was influenced by their position in the cage, particularly with regard to light, but this did not affect the ratio to the controls. Females reacted more strongly than males but the numbers of eggs laid by gravid females on a given bait were not necessarily proportionate to its attractiveness.

The efficiency of various commercial baits and repellents for blowflies was estimated by this method, and the author considers that it may also prove to be of value in research on the various aspects of their behaviour, particularly oviposition.

In the second paper, the results are given of tests designed to ascertain whether the greater response of females of *P. regina* to olfactory stimuli is due to a more acute sense of smell. Many thousand flies were tested and they were offered baits comprising 0·03, 0·1, 0·3, 1 and 3 per cent. solutions of ethyl amine in water, with equal quantities of water as controls. No reaction was obtained with the weakest solution. The next three solutions were attractive and the strongest one repellent, but since the ratios of the numbers taken in the traps to those in the controls were in all four cases about 1·59 higher for females than for males, it is concluded that the sense of smell is not the only factor involved ; if it were, the repellent material would give a lower ratio for females than for males. It appears that the total reaction to an odour is made up of three components : a positive food reaction common to both sexes, a positive oviposition reaction peculiar to females, which comes into operation at a lower odour intensity than the feeding reaction but bears a constant relation to it, and a negative protective reaction with a higher threshold than either of the other two. These three components may be combined in varying proportions and together give the total response.

Further tests showed that the ratio of attractiveness of the 0·3 per cent. ethyl amine solution was less for sexually immature than for mature adults, and the difference between the reactions of males and females was in this case less marked.

In view of the proved attractiveness of water to the flies, tests were carried out to ascertain whether its presence in a bait solution increased the attractiveness of the latter to one sex more than to the other ; the results showed, however, that while moist baits were more attractive than dry ones, the presence of water in the amine solution did not account for the difference in attractiveness to males and females.

Blanc (G.), Baltazard (M.) & Martin (L. A.). **Contribution à l'étude du comportement des microbes pathogènes chez les insectes hématophages. Deuxième mémoire.**—*Arch. Inst. Pasteur Maroc* **3** pt. 3 pp. 51–73, 6 refs. [Casablanca] 1945.

Detailed accounts are given of experiments on the behaviour of the bacilli of avian pasteurellosis (*Pasteurella avicida*) and anthrax (*Bacillus anthracis*) in *Xenopsylla cheopis*, Roths. In the five experiments with *P. avicida*, fleas acquired the infection when they fed on infected mice and injection into mice demonstrated the survival of the bacilli in the flea for 27 hours or very rarely of a few for more than 50 hours. However, the fleas did not transmit pasteurellosis by biting. In experiments with *B. anthracis*, fleas became infected after feeding on a guineapig at the septicaemic stage of the disease but did not transmit the infection by biting, even a short time after ingesting blood rich in bacilli. Bacilli were found in the excreta as well as in the fleas, but there was no evidence of multiplication in the intestines. The duration of infection in the flea was never more than ten days and was in proportion to the size of the infective meal. The behaviour of these bacilli in the fleas is contrasted with that of various others [*cf. R.A.E.*, B **30** 51 ; **34** 103 ; **35** 62] ; the authors believe that the behaviour of organisms in blood-sucking Arthropods is a character of systematic importance. The mechanism of the disappearance of the bacilli from the fleas' intestines was studied, but no explanation was found.

RISTORCELLI (A.). **Les puces des rats de Casablanca.**—*Arch. Inst. Pasteur Maroc* **3** pt. 3 pp. 99–104, 5 graphs, 1 ref. [Casablanca] 1945.

Examination of fleas taken on rats at Casablanca in 1933 and 1934 showed them to comprise 62,826 examples of *Xenopsylla cheopis*, Roths., 28,668 of *Leptopsylla* (*Ctenopsylla*) *segnis*, Schönh., 1,487 of *Nosopsyllus* (*Ceratophyllus*) *fasciatus*, Bosc, 2,786 of *Ctenocephalides felis*, Bch., 577 of *C. canis*, Curt., 115 of *Pulex irritans*, L., two of *Stenoponia* (*Hystrichopsylla*) *tripectinata*, Tirab., and 39,050 of *Echidnophaga gallinacea*, Westw. [*cf. R.A.E.*, B **22** 179]. The seasonal distribution of the eight species is discussed. *X. cheopis* showed the least seasonal variation, but was somewhat more abundant from April to October than at other times.

RISTORCELLI (A.). **Sur les phlébotomes du Maroc. Troisième note.**—*Arch. Inst. Pasteur Maroc* **3** pt. 3 pp. 105–109, 2 figs., 6 refs. [Casablanca] 1945.

In this third paper of a series [*cf. R.A.E.*, B **34** 186], some additional records of *Phlebotomus* in Morocco are given as a result of collections in an east-central locality in 1942–44, and the known distribution in Morocco of the species and varieties that have been found there is reviewed. The author corrects the identification of one of the species recorded in the second part of this series and considers that one of the new varieties described in that part is not valid.

MOULTON (F. R.). Ed. **A Symposium on Relapsing Fever in the Americas.**—*Publ. Amer. Ass. Advanc. Sci.* no. 18, 10½×7½ ins., [5+] 130 pp., 12 figs., 6 maps, refs. Washington, D.C., 1942. Price $3.

The 20 papers of which this symposium is composed together constitute a comprehensive and documented discussion of relapsing fever as it occurs in the United States and Panama. In addition to those abstracted below, they comprise some that are introductory or deal with the symptomatology or parasitology of the disease and three that have already been noticed *viz.* **"Species Unity or Plurality of the Relapsing Fever Spirochetes,"** by G. E. Davis [*R.A.E.*, B **31** 176], **"Tick Vectors and Life Cycles of Ticks,"** by G. E. Davis [**31** 177] and **"Determination of *Ornithodoros* Species,"** by R. A. Cooley [**31** 178].

FISHER (W. M.). **Present Distribution of Relapsing Fever in Oklahoma** (pp. 15–19, 2 maps, 4 refs.). Relapsing fever in man is known in four counties of Oklahoma, where 15 cases in all have been recorded since 1934. Individuals of *Ornithodoros turicata*, Dugès, infected with relapsing-fever spirochaetes have been collected in one of these counties and one other and uninfected individuals in one of these and four others. Conditions in two of the counties where human cases occurred and histories of infections there are similar. Each had only one case, a farm resident who denied all knowledge of ticks. In a third county, however, an entire family received bites while sheltering in a storm cellar in April 1940 and developed symptoms of relapsing fever 4–6 days later. *O. turicata* was collected on the premises in June, when it was very numerous in the cellar, but the few examples examined were not infective. Of a large number collected from the cellar in July, considerably more than half the adults were infective for rats. The possible hosts of the ticks and the circumstances in which the latter became infected are discussed. The cellar was treated in the winter of 1940 in an attempt to eradicate the ticks, and in the summer of 1941, rats and mice were seen in the cellar, but 20 U.S. gals. earth yielded only three ticks. One of these was infected, as were its offspring, but the mice examined were not.

BECK (M. D.). **Present Distribution of Relapsing Fever in California** (pp. 20–25, 15 refs.). From 1921 to the end of 1941, 253 cases of relapsing fever were reported in California. They occurred in 21 counties, mostly in the easterly mountainous district at elevations of more than 5,000 ft., but three cases

were reported in persons whose sources of infection were situated at less than 1,000 ft. In field investigations in 1931 and 1932, in the three areas in which cases were known to have occurred in the ten previous years, when the disease was not notifiable, 905 rodents were examined and two strains of the relapsing fever spirochaete were isolated from tamarack squirrels [*Sciurus douglasii*] and 11 from chipmunks [*Eutamias*] ; a field worker developed relapsing fever six days after contaminating his hands with the blood of an infected tamarack squirrel. Search for the vector in subsequent years showed that the occurrence of many cases in individual cabins, sometimes over a period of years, in resort areas was attributable to transmission by *Ornithodoros hermsi*, Wheeler, taken into the cabins by rodents nesting there [*cf. R.A.E.*, B **23** 221 ; **24** 207]. *O. hermsi* was later found infected or uninfected in other parts of California at altitudes of more than 5,000 ft. and it is considered the probable vector of all cases at such altitudes, while *O. parkeri*, Cooley, was found associated with one case at 250 ft. [**30** 130]. *O. talaje*, Guér., and *O. turicata*, Dugès, occur in California, but are not known to transmit relapsing fever there.

Coleman (J. M.) & Wright (H. E.). **The present Distribution of Relapsing Fever in Texas** (pp. 26-28, 1 map, 2 refs.). Cases of relapsing fever have been reported intermittently in Texas since 1927 at least. The number of cases recorded in each of the years 1933-41 is given in a table. Incidence is shown to have increased from 1933 to 1937 and then declined progressively. The seasonal trend and geographical distribution of 164 cases that have occurred since 1935 are discussed. The vector, *O. turicata*, Dugès, has been found in all sections of Texas. It occurs in the dust of limestone caverns in the central part of the State where the disease is most prevalent.

Clark (H. C.). **Relapsing Fever in Panama** (pp. 29-34, 13 refs.). Incidence of relapsing fever in Panama and the Panama Canal Zone is low, according to hospital records, but there are probably more cases among rural native children than the records indicate. Tolerance is apparently gained very early, and the disease is not of great importance. The new-type canvas beds that have almost entirely replaced the immovable board or bamboo beds have done much to clear rural huts of ticks. The first case to be established by microscopic examination occurred in 1905. The local vectors are *Ornithodoros talaje*, Guér., which feeds on mammals, birds and reptiles, but not readily on man [*cf. R.A.E.*, B **21** 284] and *O. venezuelensis*, Brumpt, which is considered the chief vector from man or animals to man. Dunn's work on vectors in Panama and Colombia [*cf.* **15** 158–159, etc.] and literature on the species of spirochaetes concerned [**10** 173] are reviewed, and experimental animals and the animal reservoir are discussed. Infection has been found in monkeys (*Leontocebus* and *Cebus*), opossums (*Didelphis*), armadillos (*Dasypus*), *Grison canaster*, cattle, horses and mules.

Johnstone (H. G.). **The Taxonomy of the Relapsing Fever Spirochetes** (pp. 35–40, 43 refs.). The literature on the classification of relapsing-fever spirochaetes is reviewed, and the opinion is expressed that until enough information is available to clarify the classification, some name agreeable to all, such as *Treponema recurrentis*, should be adopted ; *recurrentis* has priority over *obermeieri*. Each strain should be designated by the locality in which it occurs and its specific intermediate host. The morphology of the spirochaetes is discussed.

Francis (E.). **The Longevity of fasting and non-fasting** *Ornithodoros turicata* **and the Survival of** *Spirochaeta obermeieri* **within them** (pp. 85–88, 2 figs., 4 refs.). Observations made from 1931 to 1938 on naturally infected individuals of *Ornithodoros turicata*, Dugès, collected in caves in Texas [*R.A.E.*, B **27** 140] are summarised, and an account is given of further ones made from 1938 until 17th July 1941 when the last tick died. Ticks of the first batch survived a third period of starvation for as long as 3 years and 10 months, ticks of the

second batch a third starvation for as long as $2\frac{3}{4}$ years, and ticks of the third batch a second starvation of $2\frac{1}{2}$ years, and a third ranging as long as $1\frac{1}{2}$ years. Eleven ticks lived 5–6 years, seven 6–7 years, eight 7–8 years, four 8–9 years and two 9–10 years. The greatest length of life observed was 9 years, 10 months and 7 days, but the age of the tick at collection was not known and must make the total age at least ten years. Of the 32 ticks that lived five years or longer, 30 were females [*cf.* **31** 201 ; **33** 187]. Notes are given on the times that elapsed between engorgement, pairing and oviposition, and the length of life after oviposition.

Wheeler (C. M.). **The Distribution of the Spirochete of California Relapsing Fever within the Body of the Vector,** *Ornithodoros hermsi* (pp. 89–99, 6 figs., 30 refs.). Literature on the development cycle of relapsing-fever spirochaetes in the Arthropod vectors, mainly ticks, is reviewed. Some authors are shown to have believed that the spirochaetes in the tick produce granule forms, which subsequently give rise to a new generation of young spirochaetes, while others thought that the spirochaetes existed as such in the body of the tick and that granules had no part in the life-cycle [*cf. R.A.E.*, B **28** 66–67]. The fact that in a large series of experiments on the transmission of Californian relapsing fever, all infections resulted from the bites of naturally infected ticks (*Ornithodoros hermsi*, Wheeler), whether these were fed on white mice, monkeys or man [**24** 61 ; **27** 131], led to the conclusion that the spirochaetes or some developmental stage must be concentrated within the salivary glands of the tick and flow with the saliva into the wound made by its mouth-parts and thence into the peripheral blood. An account is given of a preliminary study undertaken primarily to locate the spirochaetes or some developmental form in the salivary glands, and also to find the process of development and the general distribution of the spirochaetes after ingestion by *O. hermsi*. The methods used are described. It was shown that the spirochaetes begin to migrate and penetrate the gut walls of *O. hermsi* within three hours of ingestion of infected blood ; they invade the body cavity by the third day or possibly earlier ; the process of transverse division apparently continues in the gut contents several days after ingestion of the spirochaetes by the tick ; from the tenth day, spirochaetes may be found in various muscles of the tick's body as well as in the body cavity ; and spirochaetes, recognisable as such, are present in the gut contents up to at least 38 days after the infective meal. Careful search of sections of two ticks found naturally infected and proved infective failed to reveal any recognisable spirochaetes or " infective granules " in any of the body organs. The failure to locate spirochaetes in the salivary glands of ticks known to be infected or infective is discussed.

Wynns (H. L.). **The Epidemiology of Relapsing Fever** (pp. 100–105, 3 maps, 10 refs.). The first case of tick-borne relapsing fever known to have occurred in the United States was contracted in Texas in 1905, and the disease was later recorded from 13 western States and British Columbia. Reported incidence is greatest in California and Texas. The species of *Ornithodoros* that have been proved to be vectors in the United States are *O. turicata*, Dugès, *O. hermsi*, Wheeler, and *O. parkeri*, Cooley ; *O. talaje*, Guér., is not known to have transmitted the disease to man there, though it has been found infected in nature in Arizona [*R.A.E.*, B **29** 145 ; *cf.* also **32** 195]. Areas of California in which ticks and rodents have been found infected and associated with cases, and the geographical distribution of cases of relapsing fever in the State according to their sources of infection are shown on maps. Many rodents have been found infected in nature in various south-western States and Panama. The 253 cases that were reported in California from 1921 to 1941 [*cf.* **35** 200] are analysed according to date of onset, age and sex, methods of diagnosis, number of relapses and type of dwelling occupied. Data are also given on incubation period. More than 66 per cent. of the cases occurred in July and August, often shortly after opening a summer cottage. Winter cases are attributed to ticks

leaving their winter quarters in rodent nests within cabins and seeking blood-meals. As 164 of the cases occurred in some type of permanent dwelling, it is presumed that rodents nesting in such dwellings provide the ticks with suitable quarters and if the nests are empty the ticks are attracted to the human occupants. Control depends on reduction of the rodent reservoir.

Bohls (S. W.). **Public Health Aspects of Relapsing Fever** (pp. 125–130, 36 refs.). Literature on endemic relapsing fever in the United States is reviewed. The prevention or control of sporadic cases of infection acquired through ticks or the tissues of reservoir hosts is considered the most important aspect of the problem of relapsing fever from the public health point of view, but the risk of epidemicity also requires consideration. Control should be directed to ticks, their habitat and food supply. Infected *Ornithodoros* are always a menace. Infected colonies, even if localised, are foci for possible dissemination to new habitats, and infected hosts may travel to uninfected colonies of ticks. Where colonies of infected ticks inhabit caverns, it would often be advisable to attempt control. It is doubtful whether fumigation could be widely used, but heavy sprays would be effective in some caverns and possibly some burrows. Certain areas in inaccessible districts should be fenced off to exclude hunters and picnickers. Burning of vegetation is likely to be wasteful and ineffective. Where ticks become established about dwellings, dust beneath floors should be liberally sprayed with creosote. Rats and their food and nests should be destroyed. Control in summer cabins and camp sites is difficult, but rodents should be controlled and creosote applied to wood, and beds and bedding should be treated as against bugs [*Cimex*]. The usefulness of parasites of ticks is very briefly discussed. The literature on reservoirs is reviewed, and it is also noted that Manteufel in 1908 showed that some strains of relapsing fever could be transmitted from rat to rat by the louse, *Polyplax* (*Haematopinus*) *spinulosa*, Burm., and Sergent recovered spirochaetes from naturally infected individuals of *Rhipicephalus sanguineus*, Latr., on dogs [*cf. R.A.E.*, B **24** 46, etc.]. Exposure to ticks should be avoided, protective clothing should be worn, and frequent searches should be made for attached ticks and these removed at once. Precautions advisable in the laboratory are discussed, and points requiring further study or attention are indicated.

Peredo Reyes (E.). **El cultivo del arroz y sus relaciones con el paludismo en el Estado de Morelos.** [Rice-growing and its Relation to Malaria in the State of Morelos.]—*Rev. Soc. mex. Hist. nat.* **6** no. 3–4 pp. 161–178, 4 pls., 3 graphs, 5 refs. Mexico, D.F., 1945.

As *Anopheles pseudopunctipennis*, Theo., breeds extensively in the rice-fields of the State of Morelos, Mexico, and is a vector of malaria there [*cf. R.A.E.*, B **30** 108], experiments were carried out in 1941–43 in Miacatlán to estimate the value of intermittent irrigation as a method of control. The main rice-fields, into which the seedlings are transplanted, are under water from June to October, through the hottest months of the year, and it was during this period that the largest numbers of *A. pseudopunctipennis* were taken in traps, the largest catches in 1941 occurring in August. Observations on its life-cycle during that month showed that the egg, larval and pupal stages lasted two, eight and three days, respectively. In preliminary tests in 1941, the numbers of larvae were consistently lower in a plot subjected to intermittent periods of drainage than in one under normal cultivation, no larvae being present for a short time after each period of drainage, and in 1942, it was found that flooding for periods of 3–7 days alternating with drainage for 3 5 days gave better results than flooding for 7–10 days with the same drainage periods. The best results were obtained on fairly permeable soil, or in terraced fields on slopes ; the yield of rice was in no way diminished and the quality was improved. Most of the rice-fields, however, were on clay soil, which is the most suitable for rice cultivation

but does not drain readily. Pools of stagnant water were left in many places when irrigation was interrupted, and the digging of ditches to drain them caused a great deal of the soil to be carried away with the water.

In 1943, the rice was planted along trenches and subjected to intermittent irrigation or a continuous flow of water along them. An estimated reduction of 60–80 per cent. in the numbers of Anopheline larvae was obtained with intermittent irrigation, and of over 90 per cent. with continuously running water. The latter method was most effective on gradients, but the water flowed too slowly on level ground. Both the new methods showed slightly better yields than those in current use, though the differences were not significant ; the costs were very similar.

Villalobos C. (E.) & Valderrama Delgado (A.). **El *Anopheles punctimacula* en el Perú.** [*A. punctimacula* in Peru.]—12 pp. Lima, Dir. gen. Salub., Serv. nac. antimalar., 1944.

Although *Anopheles punctimacula*., D. & K., had apparently not been recorded from Peru prior to 1942, it is now common in the district of Lima [*cf. R.A.E.*, B **34** 148] and is increasing. It constituted 80 per cent. of the Anophelines taken in buildings in two localities in April–July, 1944. Numerous breeding places occur in the coastal area, and in addition to the shaded and sometimes polluted water in which the larvae usually occur, they have frequently been observed in still, clear, sunny water, together with those of *A. pseudopunctipennis*, Theo. The importance of *A. punctimacula* as a vector of malaria has not been definitely established [*cf.* **34** 148], but in the course of the authors' investigations, although dissection of about 1,000 females gave negative results, four of 135 taken in a house inhabited by two chronic malaria patients situated at a place some 13 imles from Lima, and two of 93 taken at a place 18 miles from Lima, showed sporozoites in the salivary glands. *A. pseudopunctipennis* is still considered to be the main vector, however.

Dumbleton (L. J.). **Note on *Bironella* (*Brugella*) *hollandi* Taylor.**—*N. Z. J. Sci. Tech.* **27** (B) no. 3 pp. 250–253, 1 fig., 1 ref. Wellington, N.Z., 1946.

The distribution of *Bironella hollandi*, Taylor, in the Solomon Islands is given, together with notes on its breeding places, life-cycle and habits and a description of the egg [*cf. R.A.E.*, B **35** 161].

Perry (W. J.). **Keys to the larval and adult Mosquitoes of Espiritu Santo (New Hebrides) with Notes on their Bionomics.**—*Pan-Pacif. Ent.* **22** no. 1 pp. 9–18, 2 refs. San Francisco, Calif., 1946.

During a year's observations made throughout the wet and dry seasons in coastal areas of Espiritu Santo at altitudes below 1,000 ft. and limited work on other islands in the New Hebrides, 18 species of mosquitos were collected. Keys to the fourth-instar larvae and females of these species, based on material collected and reared on Espiritu Santo, are given, together with notes on their bionomics. *Anopheles farauti*, Lav., the only Anopheline taken, is stated to be the most important as a vector of malaria and filariasis [*Filaria bancrofti*] in the New Hebrides and Solomon Islands [*cf. R.A.E.*, B **34** 123].

Usinger (R. L.). **Notes on Cuban Triatominae (Hemiptera, Reduviidae).**—*Pan-Pacif. Ent.* **22** no. 1 pp. 19–20. San Francisco, Calif., 1946.

In the course of examination of types and other specimens of Triatominae in Cuba, the author concluded that *Nesotriatoma bruneri*, Usinger [*R.A.E.*, B **34** 54] is a synonym of *N. flavida*, Neiva. He also found that a specimen

of *N. flavida* in the Gundlach collection is labelled *Rhodnius prolixus*, Stål, and states that this is undoubtedly the source of subsequent records of *R. prolixus* for Cuba.

PAPERS NOTICED BY TITLE ONLY.

BLANC (G.) & WOODWARD (T. E.). **The Infection of** *Pedicinus albidus* **Rudow, the Maggot's Louse** (*Macaca sylvanus*) **on Typhus carrying Monkeys.**—*Arch. Inst. Pasteur Maroc* **3** pt. 3 pp. 81–85, 2 figs., 5 refs. [Casablanca] 1945. [See *R.A.E.*, B **34** 49.]

CRISTOL (S. J.) & HALLER (H. L.). **The Chemistry of DDT—a Review.**—*Chem. Engng News* **23** pp. 2070–2075, 4 figs., 49 refs. Easton, Pa., 1945.

CRISTOL (S. J.) & HALLER (H. L.). **Dehydrochlorination of 1-Trichloro-2-*o*-chlorophenyl-2-*p*-chlorophenylethane** (*o-p'*-**DDT Isomer**).—*J. Amer. chem. Soc.* **67** pp. 2222–2223, 7 refs. Easton, Pa., 1945.

CRISTOL (S. J.) & HALLER (H. L.). [Chemistry of] **Bromine Analogs of DDT.**—*J. Amer. chem. Soc.* **68** pp. 140–141, 3 refs. Easton, Pa., 1946.

PAGE (A. B.). **Insecticides and their Application, 1939–1945** [a review of recent developments].—*Emp. Cott. Gr. Rev.* **23** no. 2 pp. 90–101. London, 1946.

SERIAL PUBLICATIONS EXAMINED.

It has been suggested that it would be of value to readers to know what journals and other publications are regularly examined in the course of the preparation of the *Review of Applied Entomology*. The present list is intended to supply that need. It is hoped that it will not only serve this purpose but prompt users of the *Review* to bring any omissions to our notice.

The Institute Library obtains, either by gift or exchange, most of the publications of a purely entomological nature and many others that contain a greater or lesser amount of entomological matter. There remain many that it does not receive, but the majority of these are available in libraries in the immediate vicinity. The disposition of those at present regularly examined is as follows :—

1. The Institute Library. These publications are prefixed by an (e) in the list.

2. The Library of the Royal Entomological Society of London, which is in the same building.

3. The various libraries housed in the British Museum (Natural History) at South Kensington.

Even in these extensive libraries there are still some publications not represented. These are to be found in other libraries in different parts of London, and they can be examined only at intervals and as time permits. They are all of a non-entomological nature, but do from time to time contain entomological articles. It is these that present the greatest difficulty and require a great deal of labour for comparatively little result. Although a certain number of papers from such sources are abstracted, some undoubtedly fail to be noticed. For this reason the publications in question have not been included in the present list, with the exception of a few of the more important that will be found prefixed by " o ".

It is a pleasure to have this opportunity of acknowledging the unfailing co-operation of the librarians of the Royal Entomological Society of London and the British Museum (Natural History), who have not only given us every

possible facility, but are also constantly drawing our attention to articles of entomological interest.

The arrangement of the present list calls for little comment. Some of the journals—particularly those of German, Austrian and Far Eastern origin—have ceased publication, at least temporarily, as a result of war conditions, and it is not known if or when they will reappear. Such journals have been prefixed with an asterisk.

The insertion of the symbol (ent.) after the name of a publication means that the Institute Library either receives the entomological numbers only or retains only the papers on entomological subjects.

It is hoped to keep the present list up to date by publishing additions and amendments, with the Indexes to subsequent volumes of the *Review*.

We are very much indebted to those who send us reprints of their papers; it would make our task very much simpler if all authors would adopt the practice of sending in reprints, particularly of articles appearing in non-entomological journals.

SYMBOLS.

* A publication the receipt of which has been interrupted.

e A publication filed in the library of the Commonwealth Institute of Entomology.

(ent.) Only the issues of entomological interest of the series are filed.

o Publication examined irregularly.

Publications not prefixed by any symbol are those examined in the libraries of the Natural History Museum or the Royal Entomological Society of London.

BRITISH COMMONWEALTH.

UNITED KINGDOM AND CHANNEL ISLANDS.

* Abstract of Papers. Brighton and Hove Natural History Society, Hove.
* Abstracts of Dissertations approved for the Ph.D., M.Sc., and M.Litt. degrees in the University of Cambridge, Cambridge.
Abstracts of Dissertations for the degree of Doctor of Philosophy, Oxford University, Oxford.
* Abstracts of Theses accepted by the University for the Higher Degrees, Aberdeen.
* Abstracts of Theses for Doctorates. University of Durham, Durham.
Advancement of Science, London.
e Advisory Leaflet. Ministry of Agriculture and Fisheries, London. (ent.)
e Agriculture, London.
e Annals of Applied Biology, London.
Annals of Botany, London.
Annals and Magazine of Natural History, London.
e Annals of Tropical Medicine and Parasitology, Liverpool.
e Anti-Locust Memoirs, London.
e Bee World, Royston, Herts.
o Bio-chemical Journal, Cambridge.
Biological Reviews and Biological Proceedings of the Cambridge Philosophical Society, Cambridge.
Biometrika, London.
e British Abstracts. B III Agriculture, Foods, Sanitation, London.
e British Intelligence Objectives Sub-Committee. BIOS, CIOS, FIAT and JIOA reports, London. (ent.)
British Medical Journal, London.
Bulletin annuel de la Société jersiaise, Jersey.
e Bulletin. Anti-Locust Research Centre, London.
e Bulletin of Entomological Research, London.
e Bulletin. Forestry Commission, London. (ent.)
e Bulletin of Hygiene, London.
e Bulletin of the Imperial Institute, London.
e Bulletin. Ministry of Agriculture and Fisheries, London. (ent.)
e Colonial Research Reports, London.
Country-side, Kingston-on-Thames.
e Economic Series. British Museum, Natural History, London.
e Empire Cotton Growing Review, London.
Empire Forestry Journal, London.
o Empire Journal of Experimental Agriculture, Oxford.
e Endeavour, London.
Entomologist, London.
Entomologist's Monthly Magazine, London.
Entomologist's Record and Journal of Variation, London.
Essex Naturalist, Stratford.
e Forestry, London.
e Forestry Abstracts, Oxford.
Gardener's Chronicle and Agricultural Gazette, London.
Geographical Journal, London.
Glasgow Naturalist, Glasgow.
e Growmore Leaflet. Ministry of Agriculture and Fisheries, London. (ent.)
Hastings and East Sussex Naturalist, Hastings.
Heredity, London and Edinburgh.
e Hope Reports, Oxford.
e Horticultural Abstracts, East Malling.
Ibis. A quarterly journal of ornithology, London.
Irish Naturalists' Journal, Belfast.
Journal of Agricultural Science, Cambridge and London.
e Journal of the R. Agricultural Society of England, London.
Journal of Anatomy (and Physiology), London.
e Journal of Animal Ecology, London.
o Journal of the Royal Army Medical Corps, London.
o Journal of the Royal Army Veterinary Corps, London.
Journal of Botany, British and Foreign, London.
e Journal of Comparative Pathology and Therapeutics, Croydon.
Journal of the Derbyshire Archaeological and Natural History Society, London and Derby.
Journal of Ecology, London.
Journal of Experimental Biology, London.
Journal of Genetics, London.
Journal of Helminthology, London.
e Journal of the R. Horticultural Society, London.
o Journal of Hygiene, Cambridge.
o Journal of the R. Institute of Public Health and Hygiene, London.
Journal of the R. Institution of Chartered Surveyors, London.
Journal of the Linnean Society (Botany), London.

United Kingdom and Channel Islands (*contd.*)

Journal of the Linnean Society. (Zoology), London.
Journal of the Manx Museum, Douglas, I.o.M.
Journal of the Marine Biological Association of the United Kingdom, Plymouth.
Journal of the R. Microscopical Society, London.
o Journal of the R. Naval Medical Service, London.
Journal of the Northants Natural History Society and Field Club, Northampton.
o Journal of Physiology, Cambridge.
e Journal of Pomology and Horticultural Science, London.
Journal of the Quekett Microscopical Club, London.
e Journal of the Society for British Entomology, Bournemouth.
e Journal of Tropical Medicine and Hygiene, London.
o Lancet, London.
e Leaflet. Forest Products Research Laboratory, Princes Risborough, Bucks. (ent.)
e Leaflet. Forestry Commission, London. (ent.)
e Leaflet. Ministry of Agriculture, Northern Ireland, Belfast. (ent.)
London Naturalist, London.
Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Manchester.
Microscope, London.
o Monthly Bulletin of the Ministry of Health and the Public Health Laboratory Service, London.
Museums Journal. Organ of the Museums Association, London.
Natural History Magazine. British Museum, London.
Naturalist, London.
Nature, London.
New Phytologist, London.
North Western Naturalist, Arbroath.
Novitates zoologicae, London.
Papers and Proceedings of the Hampshire Field Club and Archaeological Society, Southampton.
e Parasitology, Cambridge.
Philosophical Transactions of the Royal Society, London.
Proceedings (and Reports) of the Belfast Natural History and Philosophical Society, Belfast.
Proceedings. Belfast Naturalists' Field Club, Belfast.
Proceedings of the Bournemouth Natural Science Society, Bournemouth.
Proceedings of the Cotteswold Naturalists' Field Club, Gloucester.
* Proceedings of the Coventry Natural History and Scientific Society, Coventry.
* Proceedings and Transactions of the Croydon Natural History and Scientific Society, Croydon.
Proceedings of the Dorset Natural History and Antiquarian Field Club, Dorchester.
e Proceedings of the R. Entomological Society of London, London.
* Proceedings of the Isle of Man Natural History and Antiquarian Society, Douglas, I.o.M.
Proceedings of the Isle of Wight Natural History Society, Newport, I.o.W.
Proceedings of the Leeds Philosophical and Literary Society, Leeds.
Proceedings of the Linnean Society, London.
* Proceedings and Transactions of the Liverpool Biological Society, Liverpool.
Proceedings of the Liverpool Naturalists' Field Club, Liverpool.
Proceedings of the R. Philosophical Society of Glasgow, Glasgow.
Proceedings of the R. Physical Society of Edinburgh, Edinburgh.
Proceedings of the Royal Society, London.
Proceedings of the Royal Society of Edinburgh, Edinburgh.
o Journal of the R. Sanitary Institute, London.
Proceedings of the Somersetshire Archaeological and Natural History Society, Taunton.
e Proceedings and Transactions of the South London Entomological and Natural History Society, London.
* Proceedings of the Swansea Scientific and Field Naturalists' Society, Swansea.
Proceedings of the University of Durham Philosophical Society, Durham.
Proceedings of the Zoological Society of London, London.
e Progress Report received from Experiment Stations. Empire Cotton Growing Corporation, London.
o Public Health, London.
o Quarterly Journal of Experimental Physiology, London.
Quarterly Journal of the R. Meteorological Society, London.
Quarterly Journal of Microscopical Science, London.

United Kingdom and Channel Islands (*contd.*)

* Record of Bare Facts. Caradoc and Severn Valley Field Club, Shrewsbury.
e Report of the Agricultural and Horticultural Research Station. University of Bristol, Long Ashton.
Report. Cheltenham College Natural History Society, Cheltenham.
Report of the Christ's Hospital (West Horsham) Natural History Society, Horsham.
Report and Transactions of the Devonshire Association for the Advancement of Science, Plymouth.
e Report of the East Malling Research Station, East Malling.
e Report. Experimental and Research Station, Nursery and Market Garden Industries Development Society, Ltd., Cheshunt.
e Report. Forest Products Research Board. Department of Scientific and Industrial Research, London.
Report. Freshwater Biological Association of the British Empire, Ambleside.
Report of the Hastings and St. Leonards Natural History Society, Hastings.
e Report of the London School of Hygiene and Tropical Medicine, London.
Report of the Marlborough College Natural History Society, Marlborough.
Report of the Oundle School Natural History Society, Oundle.
e Report of the Rothamsted Experimental Station, Harpenden.
Report of the Rugby School Natural History Society, Rugby.
Report of the Scottish Marine Biological Association, Glasgow.
Report of the Winchester College Natural History Society, Winchester.
Report and Transactions of the Yorkshire Philosophical Society, York.
e Review of Applied Mycology, Kew.
Salmon and Trout Magazine, London.
Science Progress, London.
e*Scientific Horticulture, Norwich.
o*Scientific Journal of the Royal College of Science, London.
Scientific Publications. Freshwater Biological Association of the British Empire, Ambleside.
e Scottish Agriculture, Edinburgh.
o Scottish Forestry Journal, Edinburgh.
e Soils and Fertilizers, Harpenden.
South Eastern Naturalist, London.
Technical Papers. Water Pollution Research. Department of Scientific and Industrial Research, London.
Transactions and Proceedings of the Botanical Society of Edinburgh, Edinburgh.
Transactions. Caradoc and Severn Valley Field Club, Shrewsbury.
Transactions of the Cardiff Naturalists' Society, Cardiff.
Transactions of the Carlisle Natural History Society, Carlisle.
Transactions and Journal of the Proceedings of the Dumfriesshire and Galloway Natural History and Antiquarian Society, Dumfries.
Transactions and Journal of the Eastbourne Natural History and Archaeological Society, Eastbourne.
e Transactions of the R. Entomological Society of London, London.
Transactions of the Hertfordshire Natural History Society and Field Club, Hertford.
Transactions of the Highland and Agricultural Society of Scotland, Edinburgh.
e Transactions. Lincolnshire Naturalists' Union, Lincoln.
Transactions of the Linnean Society of London (Botany), London.
Transactions of the Linnean Society of London (Zoology), London.
Transactions of the Norfolk and Norwich Naturalists' Society, Norwich.
Transactions and Annual Report of the North Staffordshire Field Club, Stafford.
Transactions of the Rochdale Literary and Scientific Society, Rochdale.
Transactions of the Royal Society of Edinburgh, Edinburgh.
Transactions of the Shropshire Archaeological and Natural History Society, Shrewsbury.
e Transactions of the Society for British Entomology, Bournemouth.
e Transactions of the R. Society of Tropical Medicine and Hygiene, London.
Transactions of the Suffolk Naturalists' Society, Norwich.
Transactions and Proceedings of the Torquay Natural History Society, Torquay.
Transactions of the Woolhope Naturalists' Field Club, Hereford.
Transactions of the Yorkshire Naturalists' Union, Leeds.
Transactions of the Zoological Society of London, London.
e Tropical Diseases Bulletin, London.

United Kingdom and Channel Islands (*contd.*)

United Empire. Royal Colonial Institute Journal, London.
Vasculum, Newcastle-upon-Tyne.
e Veterinary Bulletin, Weybridge.
o Veterinary Journal, London.
Wiltshire Archaeological and Natural History Magazine, Devizes.

DOMINIONS.

Australia.

e Advisory Leaflet. Division of Plant Industry. Department of Agriculture and Stock, Queensland, Brisbane. (ent.)
e Agricultural Gazette of New South Wales, Sydney.
e Australian Journal of Experimental Biology and Medical Science, Adelaide.
Australian Journal of Science, Sydney.
Australian Museum Magazine, Sydney.
Australian Naturalist, Sydney.
o Australian Veterinary Journal, Sydney.
Australian Zoologist, Sydney.
e Bulletin. Agricultural and Stock Department, Tasmania, Hobart. (ent.)
e Bulletin. Council for Scientific and Industrial Research, Australia, Melbourne. (ent.)
e Bulletin. Division of Plant Industry. Department of Agriculture and Stock, Queensland, Brisbane. (ent.)
Bulletin of the Technological Museum, Sydney.
e Entomological Leaflet. Department of Agriculture and Stock, Queensland, Brisbane.
e Journal of the Australian Institute of Agricultural Science, Sydney.
e Journal of the Council for Scientific and Industrial Research, Australia, Melbourne.
e Journal of the Department of Agriculture of South Australia, Adelaide.
e Journal of the Department of Agriculture of Victoria, Australia, Melbourne.
e Journal of the Department of Agriculture of Western Australia, Perth.
Journal and Proceedings of the Royal Society of New South Wales, Sydney.
Journal of the Royal Society of Western Australia, Perth.
e Leaflet. Department of Agriculture, Western Australia, Perth. (ent.)
o Medical Journal of Australia, Sydney.
Memoirs of the Australian Museum, Sydney.
Memoirs of the National Museum, Melbourne.
e Memoirs of the Queensland Museum, Brisbane.
North Queensland Naturalist, Cairns.
e Pamphlet. Division of Plant Industry. Department of Agriculture and Stock, Queensland, Brisbane. (ent.)
e Papers and Proceedings of the Royal Society of Tasmania, Hobart.
e Proceedings of the Linnean Society of New South Wales, Sydney.
e Proceedings of the Royal Society of Queensland, Brisbane.
e Proceedings of the Royal Society of Victoria, Melbourne.
Proceedings of the R. Zoological Society of New South Wales, Sydney.
e Queensland Agricultural Journal, Brisbane.
e Queensland Journal of Agricultural Science, Brisbane.
Queensland Naturalist, Brisbane.
Records of the Australian Museum, Sydney.
Records of the Queen Victoria Museum, Launceston.
e Records of the South Australian Museum, Adelaide.
* Report of the Australian Museum, Sydney.
e Report. Bureau of Sugar Experiment Stations, Queensland, Brisbane.
e Report. Council for Scientific and Industrial Research, Australia, Melbourne.
e Report of the Department of Agriculture and Stock, Queensland, Brisbane.
e*Report of the Department of Agriculture, Western Australia, Perth.
e*Report of the Director General of Public Health, Sydney.
e*Report. Waite Agricultural Research Institute, Adelaide.
e Service Publications. School of Public Health and Tropical Medicine, Sydney.
South Australian Naturalist, Adelaide.
e Tasmanian Journal of Agriculture, Hobart.
Trade Circular. Council for Scientific and Industrial Research. Division of Forest Products. Commonwealth of Australia, Melbourne.
e Transactions of the Royal Society of South Australia, Adelaide.
Transactions of the Royal Society of Victoria Melbourne.

Australia (*contd.*)
[Publications.] University of Queensland (Department of Biology), Brisbane.
Victorian Naturalist, Melbourne.
Western Australian Naturalist, Perth.

Australian Territory.
e*New Guinea Agricultural Gazette, Rabaul.

Canada.
Acadian Naturalist. Bulletin of the Natural History Society of New Brunswick, Fredericton.
Annales de l'ACFAS (Association canadienne française pour l'avancement des sciences), Montreal.
e Bimonthly Progress Report. Forest Insect Investigations, Ottawa.
Bulletin of the Biological Board of Canada, Toronto.
e Bulletin. Department of Agriculture, British Columbia, Victoria, B.C. (ent.)
e Bulletin. Department of Agriculture, Ontario, Toronto. (ent.)
Bulletin. National Museum of Canada, Ottawa.
e Canadian Entomologist, Guelph, Ont.
Canadian Field Naturalist, Ottawa.
e Canadian Insect Pest Review, Ottawa.
o Canadian Journal of Comparative Medicine, Gardenvale, Que.
o Canadian Journal of Public Health, Toronto.
e Canadian Journal of Research (Section D), Ottawa.
o Canadian Medical Association Journal, Montreal.
* Contributions. Royal Ontario Museum of Zoology, Toronto.
e Forêt québecoise, Quebec.
Journal of the Biological Board of Canada, Ottawa.
Naturaliste canadien, Quebec.
* Occasional Papers of the British Columbia Provincial Museum, Victoria, B.C.
e Proceedings of the R. Canadian Institute, Toronto.
e Proceedings of the Entomological Society of British Columbia, Victoria.
Proceedings and Transactions of the Nova Scotian Institute of Science, Halifax, N.S.
* Proceedings and Transactions of the Royal Society of Canada, Ottawa.
e Processed Publications. Division of Entomology. Department of Agriculture, Canada, Ottawa.
e Publications. Department of Agriculture, Canada, Ottawa. (ent.)
e Report. Department of Agriculture, British Columbia, Victoria, B.C.
e Report of the Department of Lands and Forests, Nova Scotia, Halifax, N.S.
e Report of the Department of Lands and Mines, Province of New Brunswick, Fredericton, N.B.
e Report of the Entomological Society of Ontario, Toronto.
e Report of the Forest Insect Survey, Department of Agriculture, Canada, Ottawa.
e Report. Forest Protection Service, Quebec.
e Report of the Minister of Agriculture, Department of Agriculture, Canada, Ottawa.
* Report of the Provincial Museum of Natural History and Anthropology, Province of British Columbia, Victoria, B.C.
e Report of the Quebec Society for the Protection of Plants, Quebec.
e Report of the Science Service, Department of Agriculture, Canada, Ottawa.
e Revue canadienne de biologie, Montreal.
e Scientific Agriculture, Ottawa.
e Transactions of the Royal Canadian Institute, Toronto.
Transactions of the Royal Society of Canada, Ottawa.
University of Toronto Studies, Biological Series, Toronto.

Ceylon.
e Administration Report of the Director of Agriculture, Ceylon, Colombo.
e*Bulletin of the Department of Agriculture, Ceylon, Colombo. (ent.)
e Bulletin. Tea Research Institute of Ceylon, Talawakelle.
e Ceylon Journal of Science (Section B. Zoology), Colombo.
e Leaflet. Department of Agriculture, Ceylon, Colombo. (ent.)
e Report of the Medical Officer of Health, Municipality of Colombo, Colombo.
e Spolia Zeylanica, Colombo.
e Tea Quarterly, Talawakelle.
e Tropical Agriculturist, Peradeniya.

Eire.
e Economic Proceedings of the Royal Dublin Society, Dublin.
e Journal of the Department of Agriculture, Eire, Dublin.
Proceedings of the Royal Irish Academy, Dublin.
e Scientific Proceedings of the Royal Dublin Society, Dublin.

India and Pakistan.

e*Agriculture and Animal Husbandry in India, Delhi.
* Allahabad University Studies, Allahabad.
* Bulletin of the Department of Zoology. Panjab University, Lahore.
e*Bulletin. Entomological Series. Department of Agriculture, Mysore State, Bangalore.
e*Bulletin. Indian Lac Association for Research (Indian Lac Research Institute), Namkum, Ranchi.
* Bulletin of the Madras Government Museum (New Series), Madras.
e*Bulletin of the Mysore Coffee Experiment Station. Department of Agriculture, Bangalore. (ent.)
Current Science, Bangalore.
* Half-yearly Journal of the Mysore University, Mysore.
e*Health Bulletin, India, Delhi.
Indian Ecologist, Bombay.
e*Indian Forest Records (Entomology), Delhi.
o Indian Forester, Dehra Dun.
e Indian Journal of Agricultural Science, Delhi.
e Indian Journal of Entomology, New Delhi.
e Indian Journal of Malariology, Delhi.
e Indian Journal of Medical Research, Calcutta.
e Indian Journal of Veterinary Science and Animal Husbandry, Delhi.
e Indian Medical Gazette, Calcutta.
e*Indian Medical Research Memoirs, Calcutta.
Indian Science Abstracts, Calcutta.
o Indian Veterinary Journal, Madras.
e Inter-Services Stores Preservation Technical Bulletin. Ordnance Laboratories, Cawnpore. (ent.)
* Journal and Proceedings of the R. Asiatic Society of Bengal, Calcutta.
Journal of the Bengal Natural History Society, Darjeeling.
e Journal of the Bombay Natural History Society, Bombay.
* Journal of the Department of Science of Calcutta University, Calcutta.
o Journal Indian Medical Association, Calcutta.
Journal of the Sind Natural History Society, Karachi.
Journal of the University of Bombay, Bombay.
* Memoirs of the Department of Zoology, University of the Punjab, Lahore.
e Memoirs of the Entomological Society of India, New Delhi.
e*Memoirs of the Indian Museum, Benares. (ent.)
e Miscellaneous Bulletins. Imperial Council of Agricultural Research, Delhi. (ent.)
e*Mysore Agricultural Calendar, Bangalore.
e Mysore Agricultural Journal, Bangalore.
Proceedings of the Indian Academy of Sciences, Bangalore.
* Proceedings of the Indian Science Congress, Calcutta.
Proceedings of the National Academy of Sciences, India, Allahabad.
Proceedings of the National Institute of Sciences of India, Calcutta.
* Records of the Botanical Survey of India, Calcutta.
e Records of the Indian Museum, Benares.
e*Report of the Agricultural Research Scheme. Agricultural Research Laboratories. Indian Central Jute Committee, Calcutta.
e Report. All-India Institute of Hygiene and Public Health, Calcutta.
e Report. Imperial Council of Agricultural Research, Delhi.
e*Report. Department of Agriculture, Bengal, Calcutta.
e*Report of the Department of Agriculture, Mysore, Bangalore.
e*Report. (Part i.) Department of Agriculture, Punjab, Lahore.
e Report. Department of Agriculture, Travancore, Trivandrum.
e Report of the Indian Lac Association for Research (Indian Lac Research Institute), Namkum, Ranchi.
e Report. Malaria Institute of India, Delhi.
e Report. Tea Scientific Department. United Planters' Association of Southern India, Madras.
Science and Culture, Calcutta.
e Scientific Reports. Imperial Agricultural Research Institute, New Delhi.
e Yearbook. Department of Agriculture, Madras.

New Zealand.

Bulletin of the Dominion Museum, Wellington.
e Dominion Museum Records in Entomology, Wellington.
e Dominion Museum Records in Zoology, Wellington.
e New Zealand Journal of Agriculture, Wellington.

New Zealand (*contd.*)

e New Zealand Journal of Science and Technology, Wellington.
o New Zealand Medical Journal, Wellington.
Records of the Auckland Institute and Museum, Auckland.
e Records of the Canterbury Museum, Christchurch.
e Report of the Cawthron Institute, Nelson.
e Report. Department of Agriculture, New Zealand, Wellington.
Report of the Otago University Museum, Dunedin.
Transactions and Proceedings of the Royal Society of New Zealand, Wellington.

Union of South Africa.

e Annals of the Durban Museum, Durban.
Annals of the Natal Museum, Pietermaritzburg.
Annals of the South African Museum, Cape Town.
Annals of the Transvaal Museum, Pretoria.
Bothalia. National Herbarium, Pretoria.
e Bulletin. Department of Agriculture and Forestry, Union of South Africa, Pretoria. (ent.)
e Entomology Memoirs. Department of Agriculture, Union of South Africa, Pretoria.
e Farming in South Africa, Pretoria.
Journal of the Botanical Society of South Africa, Cape Town.
e Journal of the Entomological Society of Southern Africa, Pretoria.
o Journal of the South African Veterinary Medical Association, Johannesburg.
* Journal of the South West Africa Scientific Society, Windhoek.
e Onderstepoort Journal of Veterinary Science and Animal Industry, Pretoria.
Pamphlet. South African Biological Society, Pretoria.
e Publications of the South African Institute for Medical Research, Johannesburg. (ent.)
e Report of the South African Institute for Medical Research, Johannesburg.
Report of the South African Museum, Cape Town.
Samab. South African Museums Association Bulletin, Natal.
e Science Bulletin. Department of Agriculture and Forestry, Union of South Africa, Pretoria. (ent.)
o South African Journal of Medical Science, Johannesburg.
e South African Journal of Science, Johannesburg.
o South African Medical Journal, Cape Town.
e South African Science, Johannesburg.
Transactions of the Royal Society of South Africa, Cape Town.
Tydskrif vir Wetenskap en Kuns, Bloemfontein.

COLONIES, PROTECTORATES AND MANDATED TERRITORIES.

Basutoland.

e Report of the Department of Agriculture, Basutoland, Masera.

Bermuda.

e*Agricultural Bulletin. Bermuda Department of Agriculture, Hamilton.
e Bulletin. Department of Agriculture, Bermuda, Hamilton. (ent.)
e Report of the Department of Agriculture, Bermuda, Hamilton.
e Report of the Plant Pathologist, Bermuda, Hamilton.

Borneo.

e*Report of the Sarawak Museum, Sarawak.

British Guiana.

e*Agricultural Journal of British Guiana, Georgetown.
e Report. Department of Agriculture, British Guiana, Georgetown.
e Report of the Director of Medical Services, British Guiana, Georgetown.

British Honduras.

e Report. Department of Agriculture, British Honduras, Belize.

British West Indies.

e Administration Report of the Director of Agriculture, Trinidad and Tobago, Port-of-Spain.
e*Bulletin. Department of Agriculture, Jamaica, Kingston.
Bulletin of the Institute of Jamaica, Kingston.
o Caribbean Medical Journal, Port-of-Spain, Trinidad.
Journal of the Barbados Museum and Historical Society, St. Ann's Garrison, Barbados.
Journal of the Jamaica Agricultural Society, Kingston.

British West Indies (*contd.*)

e Proceedings of the Agricultural Society of Trinidad and Tobago, Port-of-Spain.
e*Report of the Agricultural Department, Antigua, St. John.
e*Report on the Agricultural Department, Grenada, St. George's.
e*Report. Agricultural Department, Montserrat, Plymouth.
e*Report of the Agricultural Department, St. Kitts-Nevis, Bridgetown.
e Report. Agricultural Department, St. Vincent, Kingstown.
e Report. Agricultural and Marine Products Board, Bahamas, Nassau.
e Report of the Department of Agriculture, Dominica, Roseau.
e Report of the Department of Agriculture, Jamaica, Kingston.
e Report. Department of Agriculture, St. Lucia, Castries.
e Report of the Department of Science and Agriculture, Barbados, Barbados.
e Report of the Director of Agriculture, Leeward Islands, Barbados.
e Report on the Health Service, St. Lucia, Castries.
e*Report on the Medical and Sanitary Department, Grenada, St. George's.
e Report. Medical Department, St. Vincent, Kingstown.
e Tropical Agriculture, Trinidad.

Cyprus.

e*Annual Medical and Sanitary Report, Cyprus, Nicosia.
e Report of the Department of Agriculture, Cyprus, Nicosia.
e Report of the Veterinary Service, Cyprus, Nicosia.

Fiji Islands.

e Agricultural Journal. Department of Agriculture, Fiji, Suva.
e Bulletin of the Department of Agriculture, Fiji, Suva. (ent.)

Gambia.

e Report of the Department of Agriculture, Gambia, Bathurst.
e Report on the Medical and Health Services, Gambia, Bathurst.

Gold Coast.

e*Bulletin. Department of Agriculture, Gold Coast, Accra.
e Report of the Department of Agriculture, Gold Coast, Accra.
e Report of the Department of Animal Health, Gold Coast, Accra.
e Report of the Medical and Sanitary Department, Gold Coast, Accra.
e Report of the West African Cacao Research Institute, Tafo.

Hong Kong.

* Hongkong Naturalist, Hongkong.
e*Report of the Botanical and Forestry Department, Hong Kong.

Kenya.

e Bulletin of the Stoneham Museum, Kitale.
e East African Agricultural Journal, Nairobi.
e East African Medical Journal, Nairobi.
Journal of the East Africa Natural History Society, Nairobi.
Nature in East Africa, Nairobi.
e Report of the Department of Agriculture, Kenya, Nairobi.

Federation of Malaya and Singapore.

e*Bulletin from the Institute for Medical Research, Federated Malay States, Kuala Lumpur. (ent.)
e Bulletin of the Raffles Museum, Singapore.
e Gardens' Bulletin, Singapore.
e*General Series. Department of Agriculture, Straits Settlements and Federated Malay States, Kuala Lumpur.
e*Journal of the Federated Malay States Museums, Kuala Lumpur.
Journal of the Malayan Branch of the Royal Asiatic Society, London.
e Malayan Agricultural Journal, Kuala Lumpur.
e Malayan Forester, Kuala Lumpur.
* Malayan Nature Journal, Kuala Lumpur.
e Medical Journal of Malaya, Singapore.
e Report of the Department of Agriculture, Malayan Union, Kuala Lumpur.
e*Report of the Institute for Medical Research, Federated Malay States, Taiping.
e*Report of the Malaria Advisory Board, Federated Malay States, Kuala Lumpur.
e*Report of the Veterinary Department, Straits Settlements and Federated Malay States, Kuala Lumpur.
e*Scientific Series. Department of Agriculture, Straits Settlements and Federated Malay States, Kuala Lumpur.

Malta.

Archivum Melitense. Journal of the Malta Historical and Scientific Society, Valetta.

e*Report of the Department of Agriculture, Malta, Valetta.

Mauritius.

e*Bulletin. Department of Agriculture, Mauritius (General Series), Réduit. (ent.)

e Bulletin. Department of Agriculture, Mauritius (Scientific Series), Réduit. (ent.)

Mauritius Institute Bulletin, Port Louis.

e Report of the College of Agriculture, Mauritius, Port Louis.

e Report of the Department of Agriculture, Mauritius, Port Louis.

e Revue agricole de l'Île Maurice, Port Louis.

Nigeria.

Nigerian Field. Journal of the Nigerian Field Society, London.

e Report on the Agricultural Department, Nigeria, Lagos.

e Report on the Medical Services, Nigeria, Lagos.

e Report of the Veterinary Department, Nigeria, Lagos.

Northern Rhodesia.

e Report of the Director of Agriculture, Northern Rhodesia, Lusaka.

e*Report of the Veterinary Department, Northern Rhodesia, Lusaka.

Nyasaland.

e Annual Medical and Sanitary Report, Nyasaland, Zomba.

e Nyasaland Agricultural Quarterly Journal, Blantyre.

e Report of the Department of Agriculture, Nyasaland, Zomba.

e Report of the Veterinary Department, Nyasaland, Zomba.

Pacific Islands.

e*Report. Department of Agriculture, British Solomon Islands Protectorate, Tulagi.

e*Report. Director of Agriculture, Tonga Islands, Nukualofa.

Seychelles.

e Report of the Department of Agriculture, Seychelles, Victoria.

e Report of the Medical Department, Seychelles, Victoria.

Sierra Leone.

e Annual Medical Report, Sierra Leone, Freetown.

e Report of the Department of Agriculture, Sierra Leone, Freetown.

Somaliland.

e*Report of the Veterinary and Agricultural Department, Somaliland, Burao.

Southern Rhodesia.

e Bulletin. Department of Agriculture, Southern Rhodesia, Salisbury. (ent.)

e Occasional Papers of the National Museum of Southern Rhodesia, Bulawayo.

Proceedings and Transactions of the Rhodesia Scientific Association, Salisbury.

e Report of the Chief Veterinary Surgeon, Southern Rhodesia, Salisbury.

e*Report of the Director of Veterinary Research, Southern Rhodesia, Salisbury.

e Rhodesia Agricultural Journal, Salisbury.

Tanganyika Territory.

e Entomological Leaflet. Department of Agriculture, Tanganyika Territory, Dar-es-Salaam.

e Pamphlet. Department of Agriculture, Tanganyika Territory, Dar-es-Salaam. (ent.)

e Report of the Department of Agriculture, Tanganyika Territory, Dar-es-Salaam.

e*Report of the Department of Veterinary Science and Animal Industry, Tanganyika Territory, Dar-es-Salaam.

Tanganyika Notes and Records, Dar-es-Salaam.

Uganda.

e Report of the Department of Agriculture, Uganda Protectorate, Entebbe.

e Report of the Medical Department, Uganda Protectorate, Entebbe.

e Report of the Veterinary Department, Uganda Protectorate, Entebbe.

Uganda Journal, Kampala.

Zanzibar.

e Medical and Sanitary Report, Zanzibar Protectorate, Zanzibar.

e Report of the Department of Agriculture, Zanzibar Protectorate, Zanzibar.

CONDOMINIUM.

Anglo-Egyptian Sudan.

e*Report of the Agricultural Research Service, Sudan, Khartoum.
Sudan Notes and Records, Khartoum.

FOREIGN COUNTRIES.

Argentine Republic.

Acta zoologica lilloana, Tucumán.
* Actas de la Academia nacional de ciencias en Córdoba, Córdoba.
e Almanaque. Ministerio de agricultura argentina, Buenos Aires.
Anales del Museo argentino de ciencias naturales Bernardino Rivadavia, Buenos Aires.
Anales del Museo de La Plata, La Plata.
e Anales de la Sociedad científica argentina, Buenos Aires.
* Anales de la Sociedad científica de Santa Fé, Santa Fé.
Boletín de la Academia nacional de ciencias en Córdoba, Córdoba.
o Boletín de la Academia nacional de medicina de Buenos Aires, Buenos Aires.
e Boletín. Estación experimental agrícola, Tucumán. (ent.)
e Boletín mensual. Dirección nacional de algodón. Ministerio de agricultura, Argentina, Buenos Aires.
e Circular. Estación experimental agrícola, Tucumán. (ent.)
Holmbergia. Revista del Centro de estudiantes del doctorado en ciencias naturales, Buenos Aires.
[Publicaciones.] Instituto de genética. Facultad de agronomía y veterinaria, Buenos Aires.
e [Publicaciones.] Instituto de sanidad vegetal, Buenos Aires. (ent.)
Memorias del Museo de Entre Ríos, Paraná.
e Notas del Museo de La Plata (Zoología), La Plata.
e Physis. Revista de la Sociedad argentina de ciencias naturales, Buenos Aires.
e Publicaciones. Estación experimental agrícola, Tucumán. (ent.)
e Publicaciones misceláneas. Estación experimental agrícola, Tucumán. (ent.)
e Publicaciones. Misión de estudios de patología regional argentina (Jujuy). Universidad de Buenos Aires, Buenos Aires. (ent.)
Revista argentina de agronomía, Buenos Aires.
o Revista de la Asociación médica argentina, Buenos Aires.
e Revista de la Facultad de agronomía y veterinaria, Buenos Aires.
e Revista industrial y agrícola de Tucumán, Tucumán.
e Revista del Instituto bacteriológico "Dr. Carlos G. Malbran," Buenos Aires.
o Revista de medicina y ciencias afines, Buenos Aires.
e Revista del Museo de La Plata (N.S. Zoología), La Plata.
e Revista de la Sociedad entomológica argentina, Buenos Aires.
e*Revista sudamericana de entomología aplicada, Buenos Aires.

Austria.

e*Abhandlungen der Zoologisch-botanischen Gesellschaft in Wien, Vienna.
e*Annalen des Naturhistorischen Museums in Wien, Vienna.
* Anzeiger der Akademie der Wissenschaften (Math.-nat. Kl.), Vienna.
* Archiv für klassifikatorische und phylogenetische Entomologie, Vienna.
* Biologia generalis. Archives internationales de biologie générale, Vienna.
* Carinthia II, Klagenfurt.
Chromosoma. Zeitschrift für Zellkern- und Chromosomenforschung, Vienna.
* Denkschriften der Akademie der Wissenschaften (Math.-nat. Kl.), Vienna.
* Entomologischer Anzeiger, Vienna.
e Flugblatt. Bundesanstalt für Pflanzenschutz in Wien, Vienna.
e Koleopterologische Rundschau, Vienna.
Mikroscopie, Vienna.
e*Mitteilungen. Bundesanstalt für Pflanzenschutz in Wien, Vienna.
* Mitteilungen des Naturwissenschaftlichen Vereins für Steiermark, Graz.
Österreichische zoologische Zeitschrift, Vienna.
e Pflanzenschutzberichte, Vienna.
* Sitzungsberichte der Akademie der Wissenschaften in Wien, Vienna.
Umwelt. Zeitschrift der biologischen Station Wilhelminenberg, Wilhelminenberg.
e*Verhandlungen der Zoologisch-botanischen Gesellschaft in Wien, Vienna.
* Wiener entomologische Zeitung, Vienna.
e Zeitschrift der Wiener entomologischen Gesellschaft, Vienna.
e Zentralblatt für das Gesamtgebiet der Entomologie, Lienz.

Belgium.

e*Acta biologica belgica, Brussels.
* Annales du Musée du Congo belge, Brussels.
e Annales de la Société belge de médecine tropicale, Brussels.
* Annales de la Société scientifique de Bruxelles, Louvain.
Annales de la Société R. zoologique de Belgique, Brussels.
* Annuaire de l'Académie des sciences, des lettres et des beaux-arts de Belgique, Brussels.
Archives de l'Institut botanique de l'Univ. de Liége, Brussels.
Biologisch Jaarboek, Antwerp.
* Bulletin de l'Académie R. de Belgique (Classe des sciences), Brussels.
e Bulletin de l'Institut agronomique et des Stations de Recherches de Gembloux, Gembloux.
e Bulletin du Musée R. d'histoire naturelle de Belgique, Brussels. (ent.)
Bulletin des séances. Institut royal colonial belge, Brussels.
e Bulletin (et Annales) de la Société entomologique de Belgique, Brussels.
Cellule, Louvain.
Exploration du Parc national Albert, Brussels.
e Lambillionea. Revue mensuelle de l'Union des entomologistes belges, Brussels.
Mémoires de l'Académie Royale de Belgique (Classe des sciences, Série II), Brussels.
e Mémoires du Musée R. d'histoire naturelle de Belgique, Brussels. (ent.)
* Mémoires de la Société R. des sciences de Liége, Brussels.
* Osiris, Bruges.
e Parasitica, Gembloux.
e Publications de l'Institut belge pour l'amélioration de la betterave, Tirlemont. (ent.)
* Recueil de l'Institut zoologique Torley-Rousseau, Brussels.

Belgian Congo.

e Bulletin agricole du Congo Belge, Brussels.
* Bulletin de la Société des recherches congolaises, Brazzaville.
e Recueil de Travaux de Sciences médicales au Congo Belge, Léopoldville.
e Revue de zoologie et de botanique africaines, Brussels.

Brazil.

e Agronomía, Rio de Janeiro.
Anais da Academia brasileira de ciencias, Rio de Janeiro.
e Anais da Faculdade de medicina de São Paulo, São Paulo.
e Anais da Sociedade de biologia de Pernambuco, Recife.
o Arquivos de biologia, São Paulo.
e Arquivos de biologia e tecnologia, Curitiba.
e Arquivos de higiene e saúde pública, São Paulo.
e Arquivos do Instituto biológico de defesa agricola e animal, São Paulo.
o Arquivos do Instituto quimico - biológico do Estado de Minas Gerais, Bello Horisonte.
e Arquivos do Museu nacional, Rio de Janeiro.
e Arquivos do Museu paranaense, Curitiba.
e Arquivos do Serviço florestal, Rio de Janeiro.
e Arquivos de zoologia do Estado de São Paulo, São Paulo.
e Biológico, São Paulo.
e Boletim de agricultura, São Paulo.
e Boletim fitossanitário, Rio de Janeiro.
e*Boletim. Instituto central de fomento económico da Bahia, Bahia. (ent.)
e Boletim do Instituto Vital Brazil, Niteroi.
e Boletim do Ministério da agricultura, Rio de Janeiro.
e Boletim do Museu nacional (Nova série. zoologia), Rio de Janeiro.(ent).
o Brasil-medico, Rio de Janeiro.
o Hospital, Rio de Janeiro.
e Memorias do Instituto Butantan, São Paulo.
e Memorias do Instituto Oswaldo Cruz, Rio de Janeiro.
e Notas agricolas, São Paulo. (ent.)
e Papéis avulsos do Departamento de zoologia, São Paulo.
e Publicações avulsas. Museu paranaense, Curitiba. (ent.)
e Publicações médicas, São Paulo. (ent.)
e Revista brasileira de biologia, Rio de Janeiro.
e Revista de entomologia, Rio de Janeiró.
e*Revista florestal, Rio de Janeiro.
e Revista medico-cirurgica do Brasil, Rio de Janeiro. (ent.)
Revista do Museu nacional, Rio de Janeiro.
e Rodriguésia, Rio de Janeiro.
e Summa brasiliensis biologiae, Rio de Janeiro. (ent.)
Zoologia, São Paulo.

Bulgaria.

Annuaire de l'Université de Sofia, Sofia.
e Bulletin de la Chambre de culture nationale (Série: biologie, agriculture et silviculture), Sofia.
e*Mitteilungen der Bulgarischen entomologischen Gesellschaft in Sofia, Sofia.
e*Mitteilungen aus den königl. naturwissenschaftlichen Instituten in Sofia, Sofia.

Burma.

e*Bulletin. Department of Agriculture, Burma, Rangoon. (ent.)
* Journal of the Burma Research Society, Rangoon.
e*Report on the Civil Veterinary Department, Burma, Rangoon.
e*Report on Working Plans, Silviculture and Entomology in Burma, Rangoon.

Chile.

* Actes de la Société scientifique du Chili, Santiago.
e Agricultura técnica, Santiago.
* Anales del Museo nacional de Chile, Santiago.
* Anales de la Universidad de Chile, Santiago.
e Biológica, Santiago.
e Boletín del Instituto bacteriológico de Chile, Santiago.
Boletín del Museo nacional de historia natural, Santiago.
Boletín de la Sociedad de biología de Concepción (Chile), Concepción.
o Revista chilena de higiene y medicina preventiva, Santiago.
e Revista chilena de historia natural, Santiago.
* Revista universitaria, Santiago.

China.

e Acta brevia sinensia, London.
Biological Bulletin of Fukien Christian University, Foochow.
* Bulletin of the Fan Memorial Institute of Biology, Peiping.
e Bulletin. Taiwan Agricultural Research Institute, Taipeh. (ent.)
* China Journal, Chungking.
e Chinese Medical Journal, Shanghai.
* Contributions from the Biological Laboratory of the Science Society of China, Nanking.
e Fukien Agricultural Journal, Foochow.
Journal of the Shanghai Science Institute, Shanghai.
* Journal of the Society of Tropical Agriculture, Taiwan.
* Journal of the West China Border Research Society, Chengtu, Szechwan.
e Lingnan Science Journal, Canton.
e*Memoirs of the Faculty of Science and Agriculture, Taihoku Imperial University, Taihoku, Formosa (Taiwan). (ent.)
Notes d'entomologie chinoise, Musée Heude, Shanghai.
e*Peking Natural History Bulletin, Peking.
e*Report. Agricultural Research Institute, Taihoku, Formosa (Taiwan).
e Sinensia Institute of Zoology, Shanghai.
e*Special Publications. Lingnan Natural History Survey and Museum, Canton. (ent.)
e Technical Bulletin. Taiwan Agricultural Research Institute, Taipeh. (ent.)
e*Transactions of the Natural History Society of Formosa (Taiwan), Taihoku.

Colombia.

Caldasia, Bogotá.
e Revista de la Academia colombiana de ciencias exactas, físicas y naturales, Bogotá.
e Revista Facultad nacional de agronomía, Medellín.

Cuba.

e Boletín. Estación experimental agronómica, Cuba, Santiago de las Vegas.
e Circular. Estación experimental agronómica, Cuba, Santiago de las Vegas.
Memorias de la Sociedad cubana de historia natural "Felipe Poey," Havana.
e Revista Kuba de medicina tropical y parasitología, Havana.

Czechoslovakia.

Acta Facultatis rerum naturalium Universitatis Carolinae, Prague.
* Acta Musei nationalis Pragae, Prague.
e Acta Societatis entomologicae Čechosloveniae, Prague.
Acta Societatis scientiarum naturalium Moraviae, Brno.
Bulletin de l'École supérieure d'agronomie Brno. Faculté d'agriculture, Brno.
* Bulletin international. Académie tchèque des sciences, Prague.
e Folia entomologica, Brno.

Czechoslovakia (*contd.*)

* Lotos. Naturwissenschaftliche Zeitschrift hrsg. vom Deutschen Naturwiss.-medizinischen Verein f. Böhmen "Lotos," Prague.
e Ochrana Rostlin, Prague.
Práce Moravské Přírodovědecké Společnosti, Brno.
Přírodovědný Sborník, Turčianský Svätý Martin.
* Publications of the Medical Faculty Brno, Brno.
* Publikationen des Königgrätzer naturwissenschaftlichen Museums in Königgrätz, Königgrätz.
* Rozpravy České Akademie Věd a Uměni, Prague.
e Sborník entomologického oddělení zemskeho Musea v Praze, Prague.
Sborník Klubu Přírodovědeckého v Brně, Brno.
* Sborník Přírodovědeckého Klubu v Třebíči, Trebitsch.
* Studien aus dem Gebiete der allgemeinen Karstforschung, der wissenschaftlichen Höhlenkunde, der Eiszeitforschung und den Nachbargebieten, Brno.
* Verhandlungen des Naturforschenden Vereines in Brünn, Brno.
* Věstník České Akademie Věd a Uměni, Prague.
e Věstník České zoologické Společnosti v Praze, Prague.
* Věstník Královské České Společnosti Náuk, Prague.

Denmark.

e Aarsoversigt, samlet ved Statens Plantepatologiske Forsøg, Copenhagen.
e Beretning fra Statens Plantepatologiske Forsøg, Copenhagen. (ent.)
Biologiske Meddelelser. K. Danske Videnskabernes Selskab, Copenhagen.
Botanisk Tidsskrift (Journal de botanique), Copenhagen.
Compte rendu des travaux du Laboratoire de Carlsberg, Copenhagen.
e Entomologiske Meddelelser, Copenhagen.
Flora og Fauna, Copenhagen.
* Folia limnologica scandinavica, Copenhagen.
Kongelige Danske Videnskabernes Selskabs Skrifter, Copenhagen.
e Maanedsoversigt over Plantesygdomme, Copenhagen.
* Meddelelser om Grønland, af Commissionen for Ledelsen af de geologiske og geographiske Undersøgelser i Grønland, Copenhagen.
e Meddelelser. Statens Plantepatologiske Forsøg, Copenhagen. (ent.)
Report of the Danish Biological Station to the Ministry of Agriculture and Fisheries, Copenhagen.
* Videnskabelige Meddelelser fra Dansk naturhistorisk Forening i København, Copenhagen.

Ecuador.

e*Boletín. Ministerio de Agricultura, Ecuador, Quito. (ent.)
* Revista del Colegio nacional Vicente Rocafuerte, Guayaquil.

Egypt.

* Bulletin of the Faculty of Science Fouad I University, Cairo.
* Bulletin de l'Institut d'Égypte, Cairo.
e*Bulletin. Ministry of Agriculture, Egypt, Cairo.
e Bulletin de la Société Fouad Ier d'Entomologie, Cairo.
o Journal of the R. Egyptian Medical Association, Cairo.
* Mémoires de l'Institut d'Égypte, Cairo.
Proceedings of the Egyptian Academy of Sciences, Cairo.

Finland.

e Acta entomologica fennica, Helsinki.
Acta forestalia fennica, Helsinki.
Acta Societatis pro fauna et flora fennica, Helsinki.
Acta Societatis scientiarum fennicae, Helsinki.
e Acta zoologica fennica, Helsinki.
e Annales entomologici fennici, Helsinki.
* Annales Universitatis Turkuensis, Turku.
Annales zoologici Societatis zoologicae-botanicae fennicae Vanamo, Helsinki.
* Bidrag till kännedom om Finlands Natur och Folk. Utgifna af Finska Vetenskaps-Societeten, Helsinki.
Commentationes biologicae (Societas scientarium fennica), Helsinki.
Luonnon Tutkija, Helsinki.
e Memoranda Societatis pro fauna et flora fennica, Helsinki.
e*Notulae entomologicae, Helsinki.
e*Valtion Maatalouskoetoiminnan Julkaisuga, Helsinki.
e*Valtion Maatalouskoetoiminnan Tiedonantoja, Helsinki.

France (including Algeria).

Abeille, Paris.
* Actes de la Société linnéenne de Bordeaux, Bordeaux.
* Afra. Cahiers d'entomologie, Paris.
e Agronomie tropicale, Nogent-sur-Marne.
* Amateur de papillons, Paris.

France (including Algiers) (*contd.*)

Annales agronomiques, Paris.
* Annales de l'Association des naturalistes de Levallois-Perret, Levallois-Perret.
e Annales de l'École nationale d'agriculture de Montpellier, Montpellier.
e Annales des épiphyties, Versailles.
Annales de la Faculté des sciences de Marseille, Marseilles.
e Annales de l'Institut agricole et des Services de recherches et d'expérimentation agricoles de l'Algérie, Algiers.
Annales de l'Institut océanographique, Paris.
Annales de l'Institut Pasteur, Paris.
* Annales du Musée colonial de Marseille, Marseilles.
e Annales de parasitologie humaine et comparée, Paris.
Annales des sciences naturelles, Paris.
e Annales de la Société entomologique de France, Paris.
Annales de la Société d'histoire naturelle de Toulon, Toulon.
Annales de la Société des sciences naturelles de la Charente-Maritime, La Rochelle.
Année biologique, Paris.
Archives d'anatomie microscopique, Paris.
Archives de biologie, Paris.
e Archives de l'Institut Pasteur d'Algérie, Algiers.
* Archives de morphologie générale et expérimentale, Paris.
* Archives du Muséum d'histoire naturelle, Paris.
Archives de zoologie expérimentale et générale, Paris.
* Botaniste, Paris.
* Bulletin de l'Association des naturalistes de la vallée du Loing, Moret-sur-Loing.
* Bulletin biologique de la France et de la Belgique, Paris.
e Bulletin de l'Institut Pasteur, Paris.
Bulletin du Laboratoire maritime de Dinard, Rennes.
Bulletin mensuel de la Société linnéenne de Lyon, Lyons.
Bulletin du Musée d'histoire naturelle de Marseille, Marseilles.
Bulletin du Muséum d'histoire naturelle, Paris.
Bulletin scientifique de Bourgogne, Dijon.
e Bulletin semestriel de l'Office national anti-acridien, Algiers.
Bulletin de la Société des amis des sciences naturelles et du Muséum de Rouen, Rouen.
e Bulletin de la Société entomologique de France, Paris.
* Bulletin de la Société d'étude des sciences naturelles d'Elbeuf, Elbeuf.
Bulletin de la Société d'études scientifiques d'Angers, Angers.
Bulletin de la Société d'études scientifiques de l'Aude, Carcassonne.
e Bulletin de la Société d'histoire naturelle de l'Afrique du Nord, Algiers.
Bulletin de la Société d'histoire naturelle des Ardennes, Charleville.
* Bulletin de la Société d'histoire naturelle de Colmar, Colmar.
* Bulletin de la Société d'histoire naturelle du Doubs, Besançon.
* Bulletin de la Société d'histoire naturelle de la Moselle, Metz.
* Bulletin de la Société d'histoire naturelle de Toulouse, Toulouse.
* Bulletin de la Société linnéenne de Normandie, Caen.
* Bulletin. Société linnéenne de Provence, Marseilles.
* Bulletin de la Société linnéenne de la Seine-Maritime, Le Havre.
e Bulletin de la Société de pathologie exotique, Paris.
* Bulletin de la Société des sciences historiques et naturelles de l'Yonne, Auxerre.
Bulletin de la Société des sciences de Nancy, Nancy.
* Bulletin de la Société des sciences naturelles et médicales de Seine-et-Oise, Versailles.
Bulletin de la Société des sciences naturelles de l'ouest de la France, Nantes.
Bulletin de la Société scientifique de Bretagne, Rennes.
Bulletin de la Société scientifique due Dauphiné, Grenoble.
Bulletin de la Société zoologique de France, Paris.
Collections du Musée de zoologie de Nancy, Nancy.
* Compte rendu de l'Association française pour l'avancement des sciences, Paris.
* Compte rendu du Congrès des sociétés savantes de Paris et des départements. Section des sciences. Paris.
Compte rendu hebdomadaire des séances de l'Académie des sciences, Paris.
e Compte rendu hebdomadaire des séances de l'Académie d'agriculture de France, Paris.

France (including Algeria) (*contd.*)

e Compte rendu hebdomadaire des séances et mémoires de la Société de biologie, Paris.
Compte rendu sommaire des séances de la Société de biogéographie, Paris.
e Coton et fibres tropicales, Paris.
Échange. Revue linnéenne, Moulins.
e Encyclopédie entomologique, Paris.
Entomologiste, Paris.
* Faune des colonies françaises, Paris.
Faune de l'Empire français, Paris.
e Médecine tropicale, Marseilles.
* Mélanges exotico-entomologiques, Moulins.
Mémoires de l'Académie des sciences, arts et belles-lettres de Dijon, Dijon.
* Mémoires de l'Académie des sciences, belles-lettres et arts de Lyon, Lyons.
* Mémoires de l'Académie des sciences, inscriptions et belles-lettres de Toulouse, Toulouse.
* Mémoires de l'Académie des sciences de l'Institut de France, Paris.
* Mémoires du Muséum national d'histoire naturelle, Paris.
e Mémoires de l'Office national anti-acridien, Algiers.
Mémoires de la Société de biogéographie, Paris.
* Mémoires de la Société d'émulation du Doubs, Besançon.
* Mémoires de la Société nationale des sciences naturelles et mathématiques de Cherbourg, Cherbourg.
* Mémoires de la Société des sciences de Nancy, Nancy.
* Mémoires de la Société des sciences physiques et naturelles de Bordeaux, Bordeaux.
Miscellanea entomologica, Paris.
La Nature, Paris.
Nouvelles archives du Muséum d'histoire naturelle de Lyon, Lyons.
Novitates entomologicae, Paris.
Procès-verbaux des séances de la Société des sciences physiques et naturelles de Bordeaux, Bordeaux.
* Procès-verbaux de la Société linnéenne de Bordeaux, Bordeaux.
* Publications du Muséum national d'histoire naturelle, Paris.
* Résultats des campagnes scientifiques accomplies par le Prince Albert I, Monaco.
e Revue d'élevage et de médecine vétérinaire des pays tropicaux, Paris.
e Revue française d'entomologie, Paris.
Revue générale de botanique, Paris.
e Revue internationale de botanique appliquée et d'agriculture tropicale, Paris.
e Revue du paludisme et de médecine tropicale, Paris.
e Revue de pathologie végétale et d'entomologie agricole, Paris.
* Revue des sciences naturelles d'Auvergne, Clermont-Ferrand.
e Revue scientifique du Bourbonnais et du centre de la France, Moulins.
e Revue technique de la protection des végétaux, Versailles.
e* Revue de zoologie agricole et appliquée, Talence.
Riviera scientifique, Nice.
Sciences. Revue de l'Association française pour l'avancement des sciences, Paris.
* Travaux des Naturalistes de la vallée du Loing, Moret-sur-Loing.
* Travaux de la Station zoologique de Wimereux, Paris.

French Colonial Empire.

e Archives de l'Institut Pasteur du Maroc, Casablanca.
e* Archives de l'Institut Pasteur de Tunis, Tunis.
e* Archives des Instituts Pasteur d'Indochine, Saigon.
* Bulletin de l'Académie Malgache, Tananarive.
e* Bulletin économique de l'Indochine, Hanoi.
e* Bulletin économique de Madagascar, Tananarive.
e Bulletin de l'Institut français d'Afrique noire, Paris.
e Bulletin de l'Institut d'hygiène du Maroc, Rabat.
Bulletin de la Société d'études océaniennes, Papeete (Tahiti).
e Bulletin de la Société des sciences naturelles du Maroc, Rabat.
Bulletin. Station océanographique de Salambô, Tunis.
e Fruits et primeurs de l'Afrique du nord, Casablanca. (ent.)
* Mémoires de l'Académie Malgache, Tananarive.
e* Mémoires de la Société des sciences naturelles du Maroc, Rabat.
e Notes africaines. Bulletin d'information et de correspondance de l'Institut français d'Afrique noire, Dakar. (ent.)
e Publications. Institut Pasteur de la Guyane et du Territoire de l'Inini, Cayenne. (ent.)
e Rapport sur le fonctionnement de l'Institut Pasteur du Maroc, Casablanca.
e Revue agricole de l'Île de la Réunion, Saint-Denis. (ent.)
e Revue agricole . . . Nouvelle-Calédonie, Nouméa. (ent.)
e* Revue médicale française d'Extrême-Orient, Hanoi.

Germany.

* Abhandlungen der Bayerischen Akademie der Wissenschaften (Math.-Phys. Kl.), Munich.
* Abhandlungen aus dem Gebiet der Auslandskunde, Hamburg.
* Abhandlungen aus dem Gebiet der Naturwissenschaften hrsg. vom Naturwissenschaftlichen Verein in Hamburg, Hamburg.
* Abhandlungen der Gesellschaft der Wissenschaften zu Göttingen, Berlin.
* Abhandlungen der Heidelberger Akademie der Wissenschaften (Math.-Phys. Kl.), Heidelberg.
* Abhandlungen aus dem Landesmuseum der Provinz Westfalen. Museum für Naturkunde, Münster in Westfalen.
* Abhandlungen und Berichte aus dem Museum für Natur- und Heimatkunde (u. d. Naturwissenschaftl. Verein in Magdeburg), Magdeburg.
* Abhandlungen der Naturforschenden Gesellschaft zu Görlitz, Görlitz.
* Abhandlungen hrsg. vom Naturwissenschaftlichen Verein zu Bremen, Bremen.
* Abhandlungen der Preussischen Akademie der Wissenschaften (Phys.-Math. Kl.), Berlin.
* Abhandlungen der Sächsischen Akademie der Wissenschaften (Math.-Phys. Kl.), Leipzig.
e Abhandlungen hrsg. von der Senckenbergischen Naturforschenden Gesellschaft, Frankfurt am Main. (ent.)
Additamenta Faunistica Coleopterorum. Mitteilungen aus dem coleopterologischen Privatlaboratorium von Ch.S. Papp, Hamburg.
e*Amtliche Pflanzenschutzbestimmungen, Berlin.
* Anatomischer Anzeiger, Jena.
e Anzeiger für Schädlingskunde, Berlin.
e*Arbeiten aus der Biologischen Reichsanstalt für Land- und Forstwirtschaft, Berlin.
e*Arbeiten über morphologische und taxonomische Entomologie aus Berlin-Dahlem, Berlin.
e*Arbeiten über physiologische und angewandte Entomologie aus Berlin-Dahlem, Berlin.
* (Wilhelm Roux) Archiv für Entwicklungsmechanik der Organismen, Leipzig.
* Archiv für Hydrobiologie, Stuttgart.
Archiv für Mikrobiologie, Berlin.
* Archiv für Naturgeschichte, Leipzig.
* Archiv für Protistenkunde, Jena.
* Archiv des Vereins der Freunde der Naturgeschichte in Mecklenburg, Rostock.
* Beihefte zum Botanischen Zentralblatt, Cassel.
e*Beihefte der "Zeitschrift für hygienische Zoologie", Berlin.
* Beiträge zur Naturdenkmalpflege, Berlin.
* Beiträge zur naturkundlichen Forschung im Oberrheingebiet, Karlsruhe i. B.
* Bericht der Bayerischen Botanischen Gesellschaft zur Erforschung der heimischen Flora, Munich.
* Bericht der Deutschen Botanischen Gesellschaft, Berlin.
e*Bericht. Institut für angewandte Botanik. Abteilung für Pflanzenschutz, Hamburg.
* Bericht der Naturforschenden Gesellschaft in Bamberg, Bamberg.
* Bericht der Naturforschenden Gesellschaft zu Freiburg i. Br., Freiburg i. Br.
* Bericht des Naturwissenschaftlichen Vereins in Dessau, Dessau.
* Bericht der Oberhessischen Gesellschaft für Natur- u. Heilkunde, Giessen.
* Bericht der Physikalisch-medizinischen Gesellschaft zu Würzburg, Würzburg.
* Bericht über die Verhandlungen der Sächsischen Akademie der Wissenschaften zu Leipzig (Math.-phys. Kl.), Leipzig.
e*Bibliographie der Pflanzenschutzliteratur (Biol. Reichsanst. f. Land- u. Forstwirtschaft), Berlin.
e*Biologie der Tiere Deutschlands, Berlin.
Biologisches Zentralblatt, Leipzig.
Bombus, Hamburg.
* Botanisches Archiv, Berlin.
* Botanisches Zentralblatt, Jena.
e*Decheniana, Bonn.
* Deutsche entomologische Zeitschrift, Berlin.
e*Deutsche entomologische Zeitschrift, Iris, Dresden.
e*Deutsche tropenmedizinische Zeitschrift, Leipzig.
* Dohrniana, Stettin.
e*Entomologische Beihefte aus Berlin-Dahlem, Berlin.
e*Entomologische Blätter, Krefeld.
* Entomologische Rundschau, Stuttgart.
* Entomologische Zeitschrift, Frankfurt am Main.

Germany (*contd.*)

e*Entomologisches Jahrbuch, Frankfurt am Main.
* Ergebnisse der Biologie, Berlin.
e*Flugblatt. Biologische Reichsanstalt für Land- und Forstwirtschaft, Berlin.
* Forschungen und Fortschritte. Korrespondenzblatt der Deutschen Wissenschaft und Technik, Berlin.
Fortschritte der Zoologie, Jena.
* Gegenbaurs morphologisches Jahrbuch, Leipzig.
e*Hygienische Zoologie. Monographien zur Biologie und Bekämpfung der Gesundheits- und Wohnungs-Schädlinge, Leipzig.
* Jahrbuch für wissenschaftliche Botanik, Berlin.
* Jahresbericht der Gesellschaft von Freunden der Naturwissenschaften in Gera, Gera.
* Jahresbericht der Schlesischen Gesellschaft für vaterländische Kultur, Breslau.
* Jenaische Zeitschrift für Naturwissenschaft, Jena.
* Kakteenkunde, Neudamm.
e*Kranke Pflanze, Dresden.
* Märkische Tierwelt, Berlin.
e*Merkblätter. Biologische Reichsanstalt für Land- und Forstwirtschaft, Berlin.
e Merkblätter. Reichsinstitut für Forst- und Holzwirtschaft, Reinbek, Bez. Hamburg. (ent.)
* Mikrokosmos, Stuttgart.
e*Mitteilungen der Biologischen Reichsanstalt für Land- und Forstwirtschaft, Berlin.
* Mitteilungen der Deutschen Entomologischen Gesellschaft, Berlin.
* Mitteilungen der Geographischen Gesellschaft und des Naturhistorischen Museums in Lübeck, Lübeck.
e*Mitteilungen der Gesellschaft für Vorratsschutz, Berlin.
* Mitteilungen über Höhlen- und Karstforschung, Berlin.
e*Mitteilungen der Münchner Entomologischen Gesellschaft, Munich.
* Mitteilungen für Naturkunde und Naturschutz, Freiburg i. Br.
* Mitteilungen des Naturwissenschaftlichen Museums der Stadt Aschaffenburg, Jena.
* Mitteilungen des Naturwissenschaftlichen Vereins für Neu-Vorpommern u. Rügen in Greifswald, Berlin.
e Mitteilungen. Reichsinstitut für Forst- und Holzwirtschaft, Reinbek, Bez. Hamburg. (ent.)
* Mitteilungen des Thüringischen Botanischen Vereins, Weimar.
e*Mitteilungen aus dem Zoologischen Museum in Berlin, Berlin.
e*Mitteilungen aus dem Zoologischen Staatsinstitut und Zoologischen Museum in Hamburg, Hamburg.
e*Monographien zur angewandten Entomologie, Berlin.
* Museumskunde, Berlin.
* Nachrichten von der Gesellschaft der Wissenschaften zu Göttingen (Math.-Phys. Kl.), Berlin.
e*Nachrichten über Schädlingsbekämpfung der I. G. Farbenindustrie Aktiengesellschaft, Leverkusen b. Köln.
e Nachrichtenblatt für den Deutschen Pflanzenschutzdienst, Berlin.
* Natur am Niederrhein, Krefeld.
e Natur und Volk, Frankfurt am Main.
* Naturae Novitates, Berlin.
* Naturschutz, Berlin.
* Naturwissenschaften, Berlin.
* Nova Acta Leopoldina, Halle a. S.
* Parnassiana, Neubrandenburg.
Phytopathologische Zeitschrift, Berlin.
e*Praktische Blätter für Pflanzenbau und Pflanzenschutz, Munich.
* Protoplasma, Leipzig.
* Schriften des Naturwissenschaftlichen Vereins für Schleswig-Holstein, Kiel.
e Senckenbergiana, Frankfurt am Main.
* Siruna Seva, Berlin.
* Sitzungsberichte der Bayerischen Akademie der Wissenschaften zu München (Math.-phys. Kl.), Munich.
* Sitzungsberichte der Gesellschaft Naturforschender Freunde zu Berlin, Berlin.
* Sitzungsberichte der Heidelberger Akademie der Wissenschaften, Heidelberg.
* Sitzungsberichte der Preussischen Akademie der Wissenschaften zu Berlin, Berlin.
* Stettiner entomologische Zeitung, Stettin.
e*Tropenpflanzer, Berlin.
e*Verhandlungen der Deutschen Gesellschaft für angewandte Entomologie, Berlin.
* Verhandlungen der Deutschen Zoologischen Gesellschaft, Leipzig.
* Verhandlungen der Gesellschaft Deutscher Naturforscher und Ärzte, Berlin.
* Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie, Stuttgart.
* Verhandlungen des Naturhistorisch-medizinischen Vereins zu Heidelberg, Heidelberg.

Germany (*contd.*)

* Veröffentlichungen aus dem Deutschen Kolonial- und Uebersee-Museum Bremen, Bremen.
e*Zeitschrift für angewandte Entomologie, Berlin.
* Zeitschrift für Botanik, Jena.
* Zeitschrift über Höhlen- und Karstforschung, Berlin.
e*Zeitschrift für hygienische Zoologie und Schädlingsbekämpfung, Berlin.
* Zeitschrift für induktive Abstammungs- und Vererbungslehre, Berlin.
* Zeitschrift für mikroskopisch-anatomische Forschung, Leipzig.
Zeitschrift für Morphologie und Ökologie der Tiere, Berlin.
* Zeitschrift für Naturforschung, Wiesbaden.
* Zeitschrift für Naturwissenschaften, Halle a.S.
* Zeitschrift für Parasitenkunde (Abt. F. Zeitschrift für wissenschaftliche Biologie), Berlin.
e Zeitschrift für Pflanzenkrankheiten (Pflanzenpathologie) und Pflanzenschutz, Stuttgart.
* Zeitschrift für Säugetierkunde, Berlin.
* Zeitschrift für Tierpsychologie, Berlin.
* Zeitschrift für vergleichende Physiologie, Berlin.
e Zeitschrift für Weltforstwirtschaft, Reinbek, Bez. Hamburg.
e*Zeitschrift für wissenschaftliche Insektenbiologie, Berlin.
* Zeitschrift für wissenschaftliche Mikroskopie und für mikroskopische Technik, Leipzig.
* Zeitschrift für wissenschaftliche Zoologie, Leipzig.
e Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, Jena.
* Zoogeographica, Jena.
* Zoologica, Stuttgart.
* Zoologische Garten, Leipzig.
* Zoologische Jahrbücher, Jena.
* Zoologischer Anzeiger, Leipzig.
* Zoologischer Bericht, Jena.

Greece.

e*Acta Instituti et Musei zoologici Universitatis Atheniensis, Athens.
* Praktika tes Akademias Athenon, Athens.

Guatemala.

Anales de la Sociedad de geografía e historia de Guatemala, Guatemala.
e Revista agrícola, Guatemala. (ent.)

Hungary.

* Acta Universitatis Szegediensis, Szeged.
* Állattani Közlemények, Budapest.
e Annales historico-naturales musei nationalis hungarici, Budapest.
Archiva biologica hungarica, Tihany.
* Botanikai Közlemények, Budapest.
e Folia entomologica hungarica, Budapest.
e Kisérletügyi Közlemények, Budapest.
e*Magyar Királyi Állami Rovartani Állomás, Budapest.
* Mathematikai és Természettudományi Értesítö, Budapest.
* Mathematikai és Természettudományi Közlemények, Budapest.

Iceland.

* Greinar, Reykjavík.
Náttúrufraedingurinn, Reykjavík.
Vísindafélags Islendinga, Reykjavík.

Iran *see* **Persia.**

Iraq.

e*Bulletin. Department of Agriculture, Iraq, Baghdad. (ent.)

Italy.

e Annali della Facoltà di agraria, Pisa.
e Annali della Facoltà di agraria di Portici, Portici.
e Annali d'igiene, Rome.
e Annali del Museo civico di storia naturale Giacomo Doria, Genoa.
e Annali della sperimentazione agraria, Rome.
e Annuario R. Museo zoologico della R. Università di Napoli, Naples.
Archivio botanico per la sistematica, fitogeografia e genetica, Forli.
o Archivio di scienze biologiche, Bologna.
Archivio zoologico (italiano), Turin.
* Atti della R. Accademia Gioenia di scienze naturali, Catania.
e Atti della Accademia nazionale dei Lincei (Rendiconti. Memorie. Cl. di sci. fis. mat. e nat.), Rome.
* Atti dell'Accademia Peloritana, Messina.
* Atti della R. Accademia Pontaniana, Naples.
* Atti della R. Accademia delle scienze fisiche e matematiche, Naples.
* Atti e memorie R. Accademia di scienze, lettere ed arti Modena, Modena.
* Atti e memorie della R. Accademia di scienze, lettere ed arti in Padova, Padua.

Italy (*contd.*)

* Atti della R. Accademia di scienze, lettere ed arti di Palermo, Palermo.

Atti della R. Accademia delle scienze di Torino, Turin.

* Atti della Fondazione scientifica Cagnola dalla sua instituzione in Poi, Milan.

* Atti dell'Istituto botanico della Università di Pavia, Milan.

Atti. Istituto veneto di scienze, lettere ed arti Venezia (Scienze mat. e nat.), Venice.

Atti del Museo civico di storia naturale di Trieste, Trieste.

Atti della Società italiana di scienze naturali, e del Museo civico di storia naturale, Milan.

* Atti della Società dei naturalisti e matematici, Modena.

* Atti della Società di scienze e lettere di Genova, Genoa.

* Atti della Società toscana di scienze naturali residente in Pisa. (a) Memorie. (b) Processi verbali. Pisa.

Bollettino dell'Associazione romana di entomologia, Rome.

e Bollettino dell'Istituto di entomologia della R. Università degli studi di Bologna, Bologna.

e Bollettino del R. Laboratorio di entomologia agraria di Portici, Portici.

e*Bollettino del Laboratorio sperimentale e R. Osservatorio di fitopatologia, Turin.

e*Bollettino del Laboratorio di zoologia generale agraria del R. Istituto superiore agrario di Portici, Portici.

* Bollettino dei Musei di zoologia e di anatomia comparata della R. Università, Genoa.

* Bollettino dei Musei di zoologia e di anatomia comparata della R. Unisità, Turin.

* Bollettino delle sedute dell' Accademia Gioenia di scienze naturali in Catania, Catania.

* Bollettino della Società adriatica di scienze naturali in Trieste, Trieste.

e Bollettino della Società entomologica italiana, Genoa.

e Bollettino della Società italiana di biologia sperimentale, Naples.

* Bollettino della Società di naturalisti in Napoli, Naples.

* Bollettino della Società di scienze naturali ed economiche di Palermo, Palermo.

e*Bollettino della Società veneziana di storia naturale, Venice.

e*Bollettino della R. Stazione di patologia vegetale, Rome.

e*Bollettino della R. Stazione sperimentale di gelsicoltura e bachicoltura di Ascoli Piceno, Ascoli Piceno.

e*Bollettino di zoologia, pubblicato dall' Unione zoologica italiana, Naples.

e Bollettino di zoologia agraria e bachicoltura della R. Università di Milano, Turin.

e*Circolare. Istituto di entomologia della R. Università degli studi di Bologna, Bologna.

e*Circolare. R. Laboratorio di entomologia agraria di Portici, Portici.

* Giornale di scienze naturali ed economiche di Palermo, Palermo.

* Marcellia. Rivista internazionale di cecidologia, Avellino.

* Memoria. R. Comitato talassografico italiano, Venice.

* Memorie della R. Accademia delle scienze di Torino, Turin.

* Memorie dell'Istituto italiano di idrobiologia Dott. Marco de Marchi, Milan.

* Memorie del R. Istituto lombardo di scienze e lettere (Cl. di scienze matematiche e naturali), Milan.

* Memorie del R. Istituto veneto di scienze, lettere ed arti, Venice.

* Memorie del Museo di storia naturale della Venezia tridentina, Trento.

e Memorie della Società entomologica italiana, Genoa.

* Memorie della Società italiana di scienze naturali e del Museo civico di storia naturale di Milano, Milan.

Monitore zoologico italiano, Florence.

Natura, Milano.

* Pubblicazioni della Stazione zoologica di Napoli, Milan.

* Rassegna faunistica, Rome.

e Redia. Giornale di entomologia, Florence.

* Rendiconti dell' Accademia delle scienze fisiche e matematiche, Naples.

* Rendiconti dell' Istituto lombardo di scienze e lettere, Milan.

e Ricerca scientifica e ricostruzione, Rome. (ent.)

e Rivista di agricoltura subtropicale e tropicale, Florence.

Rivista di biologia, Perugia.

e Rivista di biologia coloniale, Rome.

e Rivista italiana d'igiene, Pisa.

e Rivista di malariologia, Rome.

e Rivista di parassitologia, Rome.

Italy (*contd.*)

Scientia, Bologna.
Scientia genetica, Turin.
* Studi Trentini di scienze naturali, Trento.
* Thalassia, Venice.

Former Italian Colonies.

e Bollettino della Società italiana di medicina e igiene tropicale (Sezione Eritrea), Asmara.

Japan.

e*Acta Japonica medicinae tropicalis, Taihoku.
e*Annotationes zoologicae Japonenses, Tokyo.
e*Bericht des Ohara Instituts für landwirtschaftliche Forschungen, Kurashiki.
* Biogeographica, Tokyo.
* Botanical Magazine, Tokyo.
* Botany and Zoology, Tokyo.
* Bulletin of the Biogeographical Society of Japan, Tokyo.
e*Bulletin. Hokkaido Agricultural Experiment Station, Sapporo. (ent.)
* Bulteno scienca de la Fakultato terkultura, Kjušu Imperia Universitato, Fukuoka.
* Entomological World, Tokyo.
* Insect World, Gifu.
e*Insecta matsumurana, Sapporo.
* Japanese Journal of Botany, Tokyo.
e*Japanese Journal of Experimental Medicine, Tokyo.
e*Japanese Journal of Medical Sciences. VI. Bacteriology and Parasitology. Tokyo.
e*Japanese Journal of Zoology, Tokyo.
e*Journal of the Imperial Agricultural Experiment Station, Nishigahara, Tokyo.
e*Journal of the College of Agriculture, Imp. University of Tokyo, Tokyo.
* Journal. Department of Agriculture. Kyushu Imperial University, Fukuoka.
e*Journal of the Faculty of Agriculture, Hokkaido Imp. University, Sapporo.
* Journal of the Faculty of Science, Hokkaido Imperial University, Sapporo.
* Journal of the Imperial Fisheries Institute, Tokyo.
* Journal of Science of the Hiroshima University. Ser. B. Zoology. Hiroshima.
e*Kitasato Archives of Experimental Medicine, Tokyo.
* Kontyû. Tokyo Entomological Society, Tokyo.
* Lansania. Journal of Arachnology and Zoology, Tokyo.
e*Memoirs of the College of Agriculture, Kyoto Imp. University, Kyoto. (ent.)
* Memoirs of the College of Science, Kyoto Imp. University, Kyoto.
e*Mushi [Organ of the Fukuoka Entomological Society], Fukuoka.
* Natural Science and Museum, Tokyo.
e*Nippon no Kôchû, Shibuya, Tokyo.
* Oyo-Kontyû, Tokyo.
* Proceedings of the Imperial Academy (of Japan), Tokyo.
e*Report of the Hokkaido Agricultural Experiment Station, Sapporo.
e*Research Bulletin of the Imperial Tokyo Sericultural College, Tokyo.
* Science Reports of the Tôhoku Imp. University, Sendai.
* Science Reports of the Tokyo Bunrika Daigaku (Sect. B.), Tokyo.
* Studies from the Tokugawa Institute, Tokyo.
e*Tenthredo. Acta entomologica. Shinomiya Yamashina.
* Transactions of the Kansai Entomological Society, Osaka.
e*Transactions of the Sapporo Natural History Society, Sapporo.
* Zoological Magazine, Tokyo.

Korea.

* Journal of the Chosen Natural History Society, Keijo.

Mexico.

e Anales de la Escuela nacional de ciencias biológicas, Mexico.
e Anales del Instituto de biología, Mexico.
* Anales del Museo nacional de arqueología, historia, y etnografía de México, Mexico.
e Boletín. Escuela nacional de ciencias biológicas, Mexico.
e Ciencia, Mexico.
e Fitófilo, San Jacinto.
* Folletos de divulgación científica. Instituto de biología, Chapultepec.
e Medicina, Mexico. (ent.)
* Memorias y revista de la Academia nacional de ciencias "Antonio Alzate", Mexico.
e Revista del Instituto de salubridad y enfermedades tropicales, Mexico.
e Revista de la Sociedad mexicana de historia natural, Mexico.
e Tierra, Mexico.

Netherlands.

Acta Biotheoretica, Leiden.
e Acta Leidensia edita cura et sumptibus Scholae Medicinae tropicae, Leiden.
Archives du Musée Teyler, Haarlem.
Archives néerlandaises des sciences exactes et naturelles. Archives néerlandaises de physiologie de l'homme et des animaux. Amsterdam.
Archives néerlandaises de zoologie, Leiden.
e Bericht van de Afdeeling Handelsmuseum van het Indisch Instituut te Amsterdam, Amsterdam. (ent.)
* Capita zoologica, The Hague.
e Entomologische Berichten. Nederlandsche entomologische vereeniging, Amsterdam.
Fauna van Nederland, Leiden.
* Genetica, The Hague.
Handelingen van de hydrobiologische Club, Amsterdam.
Levende natuur, Amsterdam.
e Mededeelingen. Comité ter bestudeering en bestrijding van insectenplagen in bosschen, Oosterbeek.
e Mededeelingen. Instituut voor toegepast biologisch onderzoek in de natuur, Oosterbeek. (ent.)
e Mededeelingen van de Landbouwhoogeschool te Wageningen, Wageningen.
* Natura. Organ der Nederlandsche natuurhistorische vereeniging, Amsterdam.
e Natuurhistorisch maandblad, Maastricht.
Proceedings. Koninklijke Nederlandsche Akademie van wetenschappen, Amsterdam.
Temminckia, Leiden.
e Tijdschrift voor entomologie, Amsterdam.
e Tijdschrift over plantenziekten, Wageningen.
Vakblad voor biologen, Helder.
Verhandelingen der Koninklijke Nederlandsche Akademie van wetenschappen, Amsterdam.
e Verslagen en mededeelingen van den Plantenziektenkundigen dienst te Wageningen, Wageningen.
e Vlugschriften. Plantenziektenkundigen dienst te Wageningen, Wageningen.
e Zoologische mededeelingen. Rijksmuseum van natuurlijke historie te Leiden, Leiden.

Netherlands Colonies.

* Annales du Jardin botanique de Buitenzorg, Buitenzorg, Java.
e*Archief voor de Suikerindustrie in Nederland en Nederlandsch-Indië, Pasoeroean, Java.
e*Bulletin van het Deli Proefstation te Medan, Medan, Sumatra.
e Bulletin. Departement Landbouwproefstation in Suriname, Paramaribo.
e*Entomologische mededeelingen van Nederlandsch-Indië, Buitenzorg, Java.
e*Geneeskundig tijdschrift voor Nederlandsch-Indië, Batavia, Java.
e*Mededeelingen van het Algemeen Proefstation der A[lgemeene] V[ereniging van] R[ubberplanters ter] O[ostkust van] S[umatra]. Algemeene serie. Batavia, Java. (ent.)
e*Mededeelingen van het Algemeen Proefstation voor den landbouw, Buitenzorg, Java.
e*Mededeelingen van het Besoekisch Proefstation, Djember, Java.
e*Mededeelingen van het Deli Proefstation te Medan, Medan, Sumatra.
e Mededeelingen. Dep. Landbouwproefstation, Suriname, Paramaribo. (ent.)
e*Mededeelingen van den Dienst der volksgezondheid in Nederlandsch-Indië, Batavia-Weltevreden, Java.
e*Mededeelingen van het Proefstation voor vorstenlandsche tabak, Klaten, Java. (ent.)
* Natuurwetenschappelijk tijdschrift voor Nederlandsch-Indië, Buitenzorg, Java.
e Treubia, Buitenzorg, Java.
* Tropische natuur. Organ van de Nederlandsch-Indische natuurhistorische vereeniging, Weltevreden, Java.
e*Veeartsenijkundige mededeelingen. Veeartsenijkundig Laboratorium. Departement van Landbouw, nijverheid en handel, Nederlandsch-Indië, Buitenzorg, Java. (ent.)
e*Verslag van Cultuurafdeeling van het Proefstation voor de Java-suikerindustrie, Soerabaia, Java.
e Vlugschrift. Deli Proefstation te Medan, Medan, Sumatra.

Norway.

Archiv for Mathematik og Naturvidenskab, Oslo.
Avhandlinger utgitt av det Norske videnskaps-akademi i Oslo, Oslo.

Norway (*contd.*)

Bergens Museums Åarbog, Bergen.
* Bergens Museums Skrifter, Bergen.
* Hvalrådets Skrifter. Scientific results of Marine Biological Research. Oslo.
Kongelige Norske Videnskabers Selskabs Forhandlinger, Trondheim.
Kongelige Norske Videnskabers Selskabs Skrifter, Trondheim.
* Meddelelser fra det Zoologiske Museum, Oslo.
e Norsk entomologisk Tidsskrift, Oslo.
e Nytt Magasin for Naturvidenskapene, Oslo.
Skrifter utgitt av det Norske Videnskaps-Akademi i Oslo, Oslo.
* Skrifter om Svalbard og Ishavet, Oslo.
Tromsø Museums Åarshefter, Tromsø.
* Tromsø Museums Skrifter, Tromsø.

Palestine.

o Acta Medica Orientalia, Jerusalem.
e Bulletin. Agricultural Research Station, Jewish Agency for Palestine, Rehovot.
Bulletin. Independent Biological Laboratories, Palestine, Tel-Aviv.
Jerusalem Naturalists' Club Bulletins, Jerusalem.
o Journal of the Palestine-Arab Medical Association, Jerusalem.
e Report of the Department of Agriculture, Forests and Fisheries, Palestine, Jerusalem.
e Report. Department of Health, Palestine, Jerusalem.

Papal State.

* Acta pontificiae Academiae scientiarum, Rome.
* Memoriae pontificiae Academiae scientiarum Novi Lincaei, Rome.

Paraguay.

* Anales científicos paraguayos, Asunción.
* Anales del Instituto nacional de Parasitología, Asunción.

Persia (Iran).

e Archives de l'Institut d'Hessarek, Hessarek-Karadj.
e Entomologie et phytopathologie appliquées, Teheran.

Peru.

e Boletín de la Dirección general de agricultura, Perú, Lima.
e Boletín. Estación experimental agrícola de La Molina, Lima.
Boletín del Museo de historia natural "Javier Prado," Lima.
e Circular. Estación experimental agrícola de La Molina, Lima.
e Informe. Estación experimental agrícola de La Molina, Lima.
e*Memorias. Estación experimental agrícola de La Molina, Lima.

Philippines.

o Monthly Bulletin. Bureau of Health, Manila.
* Natural and Applied Science Bulletin. University of the Philippines, Manila.
e Philippine Agriculturist, Los Baños.
e Philippine Journal of Agriculture, Manila.
e Philippine Journal of Science, Manila.
* Report of the Bureau of Science, Philippine Islands, Manila.

Poland.

* Acta Societatis Botanicorum Poloniae, Warsaw.
e Annales musei zoologici polonici, Warsaw.
e Annales Universitatis Mariae Curie-Skłodowska (Sect. C, D, E), Lublin.
* Archiwum Nauk biologicznych Towarzystwa Naukowego Warszawskiego, Lwów.
* Archiwum Towarzystwa naukowego we Lwówe, Lwów.
e Bulletin entomologique de la Pologne, Wrocław.
* Bulletin international de l'Académie des sciences de Cracovie (de l'Académie polonaise des sciences), Cracow.
Chrońmy Przyrodę Ojczystą, Cracow.
* Compte rendu mensuel des séances de la Classe des sciences mathématiques et naturelles. Académie polonaise des sciences et des lettres, Cracow.
* Compte rendu des séances de la Société des sciences et des lettres de Varsovie, Warsaw.
e Fragmenta faunistica Musei zoologici polonici, Warsaw.
* Kosmos. Czasopismo Polskiego Towarzystwa przyrodników imienia Kopernika, Lwów.
* Mémoires de la classe des sciences mathématiques et naturelles, Académie polonaise des sciences et des lettres, Cracow.
e*Mémoires de l'Institut national polonais d'économie rurale à Puławy, Puławy.
* Prace Komisji Matematyczno-Przyrodniczej. Poznańskie Towarzystwo Przyjaciół Nauk, Poznań.
e*Rocznik ochrony roślin, Puławy.
* Schriften der Naturforschenden Gesellschaft in Danzig, Danzig.

Poland (*contd.*)

* Schriften der Physikalisch-ökonomischen Gesellschaft zu Königsberg in Pr., Königsberg.
e Travaux et comptes rendus. Institut polonais des recherches forestières, Warsaw. (ent.)
* Zoologica poloniae, Lwów.

Portugal.

e Agronomia Lusitana, Sacavem.
Amatus Lusitanus, Lisbon.
e Anais do Instituto de medicina tropical, Lisbon.
Archives portugaises des sciences biologiques, Lisbon.
e Arquivos do Instituto bacteriológico Câmara Pestana, Lisbon.
Arquivos do Museu Bocage, Lisbon.
* Boletim da Academia das ciências de Lisboa, Lisbon.
e Boletim. Junta nacional da cortiça, Lisbon. (ent.)
e Brotéria. Série trimestral. Ciências naturais. Lisbon.
Bulletin de la Société portugaise des sciences naturelles, Lisbon.
* Memórias da Academia das ciências de Lisboa, Lisbon.
e Memórias e estudos do Museu zoológico da Universidade de Coimbra, Coimbra.
* Naturalia, Lisbon.
o Portugaliae Acta biologica, Lisbon.
o Revista de medicina veterinaria, Lisbon.

Portuguese Colonies.

e*Arquivos da Escola médico-cirurgica de Nova Goa (Serie A & B), Bastora.

Rumania.

* Analele Academiei Române. Memoriile Sectiunii Ştiinţifice, Bucharest.
e Analele Institutului de cercetări agronomice al României, Bucharest.
* Annales scientifiques de l'Université de Jassy, Jassy.
e Archives roumaines de pathologie expérimentale et de microbiologie, Bucharest.
Buletinul Facultăţii de Ştiinţe din Cernăuţi, Czernowitz.
* Buletinul de informaţii al Grădinii botanice şi al Muzeului botanic de la Unversitatea din Cluj, Cluj.
* Buletinul de informaţii al Societăţii Naturaliştilor din România, Bucharest.
Buletinul Muzeului regional al Basarabiei, Chişinău.
e*Buletinul Societăţii Naturaliştilor din România, Bucharest.
e*Buletinul Societăţii de Ştiinţe din Cluj, Cluj.
* Bulletin du Musée régional de Bessarabie, Chişinău.
* Bulletin de la Section scientifique de l'Académie roumaine, Bucharest.
* Compte rendu des séances de l'Institut des sciences de Roumanie, Bucharest.
* Études et recherches. Académie roumaine, Bucharest.
e Notationes biologicae, Bucharest.
* Publicaţiunile Fondului Vasilie Adamachi. Academiă Română, Bucharest.
* Studii şi cercetări. Academia română, Bucharest.
* Verhandlungen und Mitteilungen des Siebenbürgischen Vereins für Naturwissenschaften zu Hermannstadt, Hermannstadt.

Siam (Thailand).

* Journal of the Thailand Research Society of natural History, Bangkok.

Spain.

* Anales del Instituto de ciencias naturales "José de Acosta," Madrid.
e Boletín del Instituto nacional de investigaciones agronómicas, Madrid.
e Boletín de patología vegetal y entomología agrícola, Madrid.
Boletín de la R. Sociedad española de historia natural, Madrid.
Boletín de la Universidad de Granada, Granada.
e Eos. Revista española de entomología, Madrid.
e Medicina colonial, Madrid.
* Memorias de la R. Academia de ciencias y artes de Barcelona, Barcelona.
e Memorias de la Academia de ciencias exactas, físico-químicas y naturales de Zaragoza, Saragossa. (ent.)
e Publicaciones (Divulgaciones). Estación de fitopatología agrícola de La Coruña, Corunna. (ent.)
e Publicaciones del Instituto de biología aplicada, Barcelona.
e Publicaciones. Servicio de lucha contra la langosta. Ministerio de agricultura, Madrid.
e Revista de la Academia de ciencias exactas, físico-químicas y naturales de Zaragoza, Saragossa.

Spain (*contd.*)

e Revista ibérica de parasitología, Granada.
o Revista de sanidad e higiene pública, Madrid.
* Revista de la Universidad de Madrid, Madrid.
* Trabajos del Instituto de ciencias naturales "José de Acosta," Madrid.

Sweden.

o Acta medica scandinavica, Stockholm.
o Acta physiologica scandinavica, Stockholm.
Acta Universitatis Lundensis, Lund.
Acta zoologica, Stockholm.
Arkiv för botanik, Uppsala.
e Arkiv för zoologi, Stockholm.
Årstryck. Göteborgs Museum, Göteborg.
Botaniska notiser, Lund.
e Entomologisk tidskrift, Stockholm.
Fauna och flora, Uppsala.
e Flygblad. Statens Växtskyddsanstalt, Stockholm.
Göteborgs Kungl. vetenskaps- och vitterhetssamhälles handlingar, Göteborg.
Hereditas, genetiskt arkiv, Lund.
Kungliga Svenska Vetenskapsakademiens årsbok, Stockholm.
Kungliga Svenska Vetenskapsakademiens handlingar, Stockholm.
Kungliga Svenska Vetenskapsakademiens skrifter i naturskyddsärenden, Stockholm.
e Meddelanden från Statens Skogsforskningsinstitut, Stockholm.
e Meddelanden. Statens Växtskyddsanstalt, Stockholm.
Nova Acta Regiae Societatis scientiarum Upsaliensis, Uppsala.
e Opuscula entomologica, Lund.
Skånes natur, Lund.
Svensk botanisk tidskrift, Stockholm.
Svenska Linnésällskapets Årsskrift, Uppsala.
* Uppsala Universitets Årsskrift, Uppsala.
e Växtskyddsnotiser. Statens Växtskyddsanstalt, Stockholm.
e Zoologiska bidrag från Uppsala, Uppsala.

Switzerland.

e Acta tropica, Basle.
Actes de la Société helvétique des sciences naturelles, Zurich.
Archives des sciences physiques et naturelles, Geneva.
Bericht. Naturhistorisches Museum der Stadt Bern, Berne.
Bericht der Schweizerischen Botanischen Gesellschaft, Berne.
* Bulletin de l'Institut national genevois, Geneva.
* Bulletin de la Murithienne. Soc. valaisanne des sciences naturelles, Sion.
e Bulletin de la Société lépidoptérologique de Genève, Geneva.
* Bulletin de la Société neuchâteloise des sciences naturelles, Neuchâtel.
Candollea. Organe du Conservatoire et du Jardin botaniques de la ville de Genève, Geneva.
Denkschriften der Schweizerischen Naturforschenden Gesellschaft, Zurich.
Experientia, Basle.
o Helvetica medica acta, Basle.
* Jahrbuch der St. Gallischen Naturwissenschaftlichen Gesellschaft, St. Gallen.
e Landwirtschaftliches Jahrbuch der Schweiz, Berne.
Mémoires de la Société helvétique des sciences naturelles, Zurich.
Mémoires de la Société neuchâteloise des sciences naturelles, Neuchâtel.
Mémoires de la Société vaudoise des sciences naturelles, Lausanne.
Mitteilungen der Aargauischen Naturforschenden Gesellschaft, Aarau.
Mitteilungen der Naturforschenden Gesellschaft in Bern, Berne.
Mitteilungen der Naturforschenden Gesellschaft in Luzern, Lucerne.
* Mitteilungen der Naturwissenschaftlichen Gesellschaft Thun, Thun.
Mitteilungen der Naturwissenschaftlichen Gesellschaft in Winterthur, Winterthur.
e Mitteilungen der Schweizerischen Entomologischen Gesellschaft, Berne.
* Mitteilungen der Thurgauischen Naturforschenden Gesellschaft, Frauenfeld.
Neujahrsblatt hrsg. von der Naturforschenden Gesellschaft in Zürich, Zurich.
* Rapport. Musées d'histoire naturelle et Jardins botaniques de Lausanne, Lausanne.
Résultats des recherches scientifiques entreprises au Parc national suisse, Aarau.
e Revue romande d'agriculture, de viticulture et d'arboriculture, Lausanne.
Revue suisse de zoologie et Annales de la Société zoologique suisse et du muséum d'histoire naturelle de Genève, Geneva.

Switzerland (*contd.*)

Schweizerische medizinische Wochenschrift, Basle.

o Schweizerische Zeitschrift für Pathologie und Bakteriologie, Basle.

Verhandlungen der Naturforschenden Gesellschaft in Basel, Basle.

Vierteljahresschrift der Naturforschenden Gesellschaft in Zürich, Zurich.

Zeitschrift für Hydrologie, Hydrographie, Hydrobiologie, Fischereiwissenschaft, Aarau.

Thailand *see* **Siam.**

Turkey.

e Çalişmalar. Ankara yüksek ziraat enstitüsü, Ankara. (ent.)

e Mahsul hekimi, Izmir.

Revue de la Faculté des sciences de l'Université d'Istanbul, Istanbul.

e Turkish Bulletin of Hygiene and Experimental Biology, Ankara.

e Ziraat vekâleti neşriyati, Ankara. (ent.)

Union of Soviet Socialist Republics.

* Abstracts of the Works of the Zoological Institute of the Moscow State University, Moscow.

* Acta Universitatis Asiae Mediae, Tashkent.

Acta Universitatis Latviensis, Riga.

* Acta et Commentationes Universitatis Tartuensis, Tartu.

* Acta Universitatis Voronegiensis, Voronezh.

Advances in Modern Biology, Moscow.

* Annales de l'Institut polytechnique du Don à Novotcherkassk, Novotcherkassk.

* Annales Societatis rebus naturae investigandis in Universitate Tartuensi constitutae, Tartu.

* Arbeiten der Limnologischen Station zu Kossino (bei Moskau), Moscow.

* Arbeiten des Naturforschervereins zu Riga, Riga.

e*Archives du Musée zoologique de l'Université de Moscou, Moscow.

Biologicheskiĭ Zhurnal', Moscow.

Bulletin de l'Académie des sciences du l'U.R.S.S., Moscow.

* Bulletin de biologie et de médecine expérimentale de l'URSS, Moscow.

e*Bulletin de l'Institut des recherches biologique de Molotov, Molotov.

* Bulletin de l'Institut scientifique de biologie et de géographie, Irkutsk.

* Bulletin de l'Institut scientifique Lesshaft, Leningrad.

e*Bulletin de l'Institut de zoologie appliquée et de phytopathologie, Leningrad.

e*Bulletin du Musée de Géorgie, Tiflis.

e*Bulletin [Vestnik] of Plant Protection. Lenin Academy of Agricultural Sciences in U.S.S.R., Leningrad.

e Bulletin de la Société des naturalistes de Moscou, Moscow.

* Bulletin de l'Université de l'Asie centrale, Tashkent.

e*Byulleten' Instituta Zernovogo Khozyaistva Yugo-Vostoka SSSR, Saratov.

e Dokladui Akademiĭ Nauk SSSR, Moscow.

e*Folia zoologica et hydrobiologica, Riga.

* Gamta, Kaunas.

e*Izvestiya Kazakhskogo Filiala Akademii Nauk. Seriya Zoologicheskaya. Seriya Parazitologicheskaya. Alma-Ata.

e*Izvestiya Uzbekistanskogo Filiala Akademii Nauk SSSR, Tashkent.

Journal of General Biology, Moscow & Leningrad.

o Journal of Physiology of USSR, Leningrad.

* Korrespondenzblatt des Naturforschervereins zu Riga, Riga.

e*Magasin de parasitologie, Leningrad.

e*Medical Parasitology and Parasitic Diseases, Moscow.

* Mémoires de la Faculté des sciences de l'Université Vytantas le Grand, Kaunas.

e*Nauchnuie Zapiski po Sakharnoĭ Promuishlennosti, Kiev.

* Nouveaux mémoires de la Société des naturalistes de Moscou, Moscow.

e*Proceedings of the Lenin Academy of Agricultural Sciences of USSR, Moscow.

e Revue d'entomologie de l'U.R.S.S., Leningrad.

e*Sotzialisticheskoe Zernovoe Khozyaĭstvo, Saratov.

e*Summary of the Scientific Research Work of the Institute of Plant Protection, Lenin Academy of Agricultural Sciences in USSR, Leningrad.

e Tableaux analytiques de la Faune de l'U.R.S.S., Leningrad. (ent.)

* Travaux de l'Institut des recherches biologiques et de la Station biologique à l'Université de Perm, Perm (Molotov).

e*Travaux de l'Institut de zoologie et biologie. (Académie des Sciences de l'Ukraine), Kiev.

Union of Soviet Socialist Republics (*contd.*)

e Travaux de l'Institut zoologique de l'Académie des Sciences de l'U.R.S.S., Leningrad.
e*Travaux du Musée zoologique, Académie des Sciences de l'Ukraine, Kiev.
e*Travaux de la Société des naturalistes. Section de zoologie et de physiologie, Leningrad.
* Travaux de la Société des sciences et des lettres de Wilno (Cl. Sci. math. nat.), Wilno.
e Travaux de la Station biologique du Caucase du Nord, Dzaudzhikau.
* Travaux de la Station hydrobiologique du Dnièpre, Kiev.
* Travaux de la Station limnologique du Lac Baikal, Leningrad.
* Travaux de la Station des sciences naturelles à Karadagh, Moscow.
* Trudui Azerbaïdzhanskogo Filiala. Akademiya Nauk SSSR, Baku.
Uchenuie Zapiski. Moskovskiĭ Gosudarstvennuiĭ Universitet, Moscow.
Vestnik. Académie des Sciences de l'URSS, Moscow.
e*Vestnik Mikrobiologii, Epidemiologii i Parazitologii, Saratov.
e Veterinariya, Moscow.
* Visti Akademii Nauk URSR, Kiev.
e*Zoologicheskiĭ Zhurnal, Moscow.

United States of America.

* Abstract of the Proceedings of the Linnaean Society of New York, New York, N.Y.
Abstracts of Doctoral Dissertations. Ohio State University, Columbus, Ohio.
e Agricultural Chemicals, Baltimore, Md.
American Journal of Botany, Lancaster, Pa.
e American Journal of Hygiene, Baltimore, Md.
o American Journal of Medical Sciences, Philadelphia, Pa.
o American Journal of Pathology, Ann Arbor, Mich.
o American Journal of Physiology, Baltimore, Md.
o American Journal of Public Health, New York, N.Y.
American Journal of Science, New Haven, Conn.
e American Journal of Tropical Medicine, Baltimore, Md.
e American Journal of Veterinary Research, Chicago, Ill.
American Midland Naturalist, Notre Dame, Ind.
American Museum Novitates, New York, N.Y.
American Naturalist, New York, N.Y.
o American Potato Journal, New Brunswick, N.J.
Anatomical Record, Philadelphia, Pa.
Annals of the Carnegie Museum, Pittsburgh, Pa.
e Annals of the Entomological Society of America, Columbus, Ohio.
Annals of the Missouri Botanical Garden, St. Louis, Mo.
Annals of the New York Academy of Sciences, New York, N.Y.
Aquarium, Philadelphia, Pa.
e Bibliographical Bulletin. United States Department of Agriculture, Washington, D.C. (ent.)
e Bibliography of Agriculture, Washington, D.C.
e Biennial Report. Kansas Agricultural Experiment Station, Manhattan, Kans.
e Biennial Report. Kansas State Horticultural Society, Topeka, Kans.
Biennial Report of the Louisiana State Museum, Baton Rouge, La.
e Bimonthly Bulletin. North Dakota Agricultural Experiment Station, Fargo, N. Dak.
e Biological Bulletin. Marine Biological Laboratory, Lancaster, Pa.
e Boletín de la Oficina sanitaria panamericana, Washington, D.C.
Botanical Gazette, Chicago, Ill.
Botanical Review, Lancaster, Pa.
Brooklyn Botanic Garden Record, Brooklyn, N.Y.
e Bulletin. Alabama Agricultural Experiment Station, Auburn, Ala. (ent.)
Bulletin of the American Museum of Natural History, New York, N.Y.
e Bulletin. Arizona Agricultural Experiment Station, Tucson, Ariz. (ent.)
e Bulletin. Arkansas Agricultural Experiment Station, Fayetteville, Ark. (ent.)
e Bulletin of the Brooklyn Entomological Society, Brooklyn, N.Y.
Bulletin of the Buffalo Society of Natural Sciences, Buffalo, N.Y.
e Bulletin. California Agricultural Experiment Station, Berkeley, Calif. (ent.)
Bulletin of the Chicago Academy of Sciences, Chicago, Ill.
e Bulletin. Colorado Agricultural Experiment Station, Fort Collins, Colo. (ent.)

United States of America (*contd.*)

e Bulletin. Connecticut Agricultural Experiment Station, New Haven, Conn. (ent.)
e Bulletin. State of Connecticut. State Geological and Natural History Survey, Hartford, Conn. (ent.)
e Bulletin. Cornell University Agricultural Experiment Station, Ithaca, N.Y. (ent.)
e Bulletin. Delaware Agricultural Experiment Station, Newark, Del. (ent.)
e Bulletin of the Department of Agriculture, State of California, Sacramento, Calif.
e Bulletin. Florida Agricultural Experiment Station, Gainesville, Fla. (ent.)
Bulletin of the George Washington University, Washington, D.C.
e Bulletin. Georgia [Agricultural] Experiment Station, Atlanta, Ga. (ent.)
e Bulletin. Georgia Department of Entomology, Atlanta, Ga.
e Bulletin. Idaho Agricultural Experiment Station, Moscow, Idaho. (ent.)
e Bulletin. Illinois Agricultural Experiment Station, Urbana, Ill. (ent.)
e Bulletin of the Illinois State Natural History Survey, Urbana, Ill.
e Bulletin. Indiana Agricultural Experiment Station, Lafayette, Ind. (ent.)
e Bulletin. Iowa Agricultural Experiment Station, Ames, Iowa. (ent.)
e Bulletin. Kansas Agricultural Experiment Station, Manhattan, Kans. (ent.)
e Bulletin. Kentucky Agricultural Experiment Station, Lexington, Ky. (ent.)
e Bulletin. Louisiana Agricultural Experiment Station, Baton Rouge, La. (ent.)
e Bulletin. Maine Agricultural Experiment Station, Orono, Me. (ent.)
e Bulletin. Maryland Agricultural Experiment Station, College Park, Md. (ent.)
e Bulletin. Massachusetts Agricultural Experiment Station, Amherst, Mass. (ent.)
e Bulletin. Minnesota Agricultural Experiment Station, St. Paul, Minn. (ent.)
e Bulletin. Mississippi Agricultural Experiment Station, State College, Miss. (ent.)
e Bulletin. Missouri Agricultural Experiment Station, Columbia, Mo. (ent.)
e Bulletin. Montana Agricultural Experiment Station, Bozeman, Mont. (ent.)
Bulletin of the Museum of Comparative Zoology at Harvard College, Cambridge, Mass.
Bulletin of the Museum of Northern Arizona, Flagstaff, Ariz.
* Bulletin of the National Research Council, Washington, D.C.
e Bulletin. Nebraska Agricultural Experiment Station, Lincoln, Neb. (ent.)
Bulletin. Nebraska State Museum, Lincoln, Neb.
e Bulletin. Nevada Agricultural Experiment Station, Reno, Nev. (ent.)
e Bulletin. New Hampshire Agricultural Experiment Station, Durham, N.H. (ent.)
e Bulletin. New Jersey Agricultural Experiment Station, New Brunswick, N.J. (ent.)
e Bulletin. New Mexico Agricultural Experiment Station, State College, N. Mex. (ent.)
e Bulletin. New York State Agricultural Experiment Station, Geneva, N.Y. (ent.)
e Bulletin of the New York State Museum of Natural History, Albany, N.Y. (ent.)
Bulletin of the New York Zoological Society, New York, N.Y.
e Bulletin. North Carolina Agricultural Experiment Station, West Raleigh, N.C. (ent.)
e Bulletin. North Dakota Agricultural Experiment Station, Fargo, N. Dak. (ent.)
e Bulletin. Ohio Agricultural Experiment Station, Wooster, Ohio. (ent.)
e Bulletin of the Ohio Biological Survey, Columbus, Ohio.
e Bulletin. Oklahoma Agricultural Station, Stillwater, Okla. (ent.)
e Bulletin. Oregon Agricultural Experiment Station, Corvallis, Ore. (ent.)
e Bulletin. Pennsylvania Agricultural Experiment Station, State College, Pa. (ent.)
e (General) Bulletin. Pennsylvania Department of Agriculture, Harrisburg, Pa. (ent.)
e Bulletin. South Carolina Agricultural Experiment Station, Clemson College, S.C. (ent.)
e Bulletin. South Dakota Agricultural Experiment Station, Brookings, S. Dak. (ent.)

United States of America (*contd.*)

Bulletin of the Southern California Academy of Sciences, Los Angeles, Calif.

e Bulletin. Tennessee Agricultural Experiment Station, Knoxville, Tenn. (ent.)

e Bulletin. Texas Agricultural Experiment Station, College Station, Tex. (ent.)

e Bulletin of the United States Army Medical Department, Carlisle, Pa.

e Bulletin. United States National Museum. Smithsonian Institution, Washington, D.C. (ent.)

Bulletin. University of Michigan School of Forestry and Conservation, Ann Arbor, Mich.

Bulletin of the University of Utah (Biological Series), Salt Lake City, Utah.

e Bulletin. Utah Agricultural Experiment Station, Logan, Utah. (ent.)

e Bulletin. Virginia Agricultural Experiment Station, Blacksburg, Va. (ent.)

e Bulletin. Virginia Truck Experiment Station, Norfolk, Va. (ent.)

Bulletin of the Wagner Free Institute of Science, Philadelphia, Pa.

Bulletin. Washington State Agricultural Experiment Station, Pullman, Wash. (ent.)

Bulletin of the West Virginia Academy of Science, Morgantown, W. Va.

e Bulletin. West Virginia Department of Agriculture, Charleston, W. Va. (ent.)

e Bulletin. West Virginia University Agricultural Experiment Station, Morgantown, W. Va. (ent.)

e Bulletin. Wisconsin Agricultural Experiment Station, Madison, Wis. (ent.)

e Bulletin. Wyoming Agricultural Experiment Station, Laramie, Wyo. (ent.)

Bulletin of the Zoological Society of San Diego, San Diego, Calif.

Butler University Botanical Studies, Indianapolis, Ind.

e California Citrograph, Los Angeles, Calif.

Charleston Museum Leaflets, Charleston, S.C.

Chicago Naturalist, Chicago, Ill.

e Circular. Alabama Agricultural Experiment Station, Auburn, Ala. (ent.)

e Circular. California Agricultural Experiment Station, Berkeley, Calif. (ent.)

e Circular. Connecticut Agricultural Experiment Station, New Haven, Conn. (ent.)

e Circular. Idaho Agricultural Experiment Station, Moscow, Idaho. (ent.)

e Circular. Illinois Agricultural Experiment Station, Urbana, Ill. (ent.)

e Circular. Illinois State Natural History Survey, Urbana, Ill. (ent.)

e Circular. Kansas Agricultural Experiment Station, Manhattan, Kans. (ent.)

e Circular. Kentucky Agricultural Experiment Station, Lexington, Ky. (ent.)

e Circular. Mississippi Agricultural Experiment Station, State College, Miss. (ent.)

e Circular. Missouri Agricultural Experiment Station, Columbia, Mo. (ent.)

e Circular. Montana Agricultural Experiment Station, Bozeman, Mont. (ent.)

e Circular. Nebraska Agricultural Experiment Station, Lincoln, Neb. (ent.)

e Circular. New Jersey Agricultural Experiment Station, New Brunswick, N.J. (ent.)

e Circular. New Jersey Department of Agriculture, Trenton, N.J. (ent.)

e Circular. New York State Agricultural Experiment Station, Geneva, N.Y. (ent.)

Circular. New York State Museum, Albany, N.Y.

e Circular. Oklahoma Agricultural Experiment Station, Stillwater, Okla. (ent.)

e Circular. Oregon Agricultural Experiment Station, Corvallis, Ore. (ent.)

e Circular. Pennsylvania Agricultural Experiment Station, State College, Pa. (ent.)

e Circular. South Dakota Agricultural Experiment Station, Brookings, S. Dak. (ent.)

e Circular. Tennessee Agricultural Experiment Station, Knoxville, Tenn. (ent.)

e Circular. Texas Agricultural Experiment Station, College Station, Tex. (ent.)

e Circular. United States Department of Agriculture, Washington, D.C. (ent.)

* Circular. University of Michigan School of Forestry and Conservation, Ann Arbor, Mich.

e Circular. Utah Agricultural Experiment Station, Logan, Utah. (ent.)

United States of America (*contd.*)

* Contributions from the Biological Laboratories in Princeton University, Princeton, N.J.
* Contributions from the Botanical Laboratory, Univ. of Pennsylvania, Philadelphia, Pa.
e Contributions from Boyce Thompson Institute, Menasha, Wis.
Contributions to Embryology. (Publications of the Carnegie Institution), Washington, D.C.
e Contributions in Zoology and Entomology, Ohio State University, Columbus, Ohio. (ent.)
o Cornell Veterinarian, Ithaca, N.Y.
e Current List of Medical Literature, Washington, D.C.
Ecological Monographs, Durham, N.C.
Ecology, Brooklyn, N.Y.
e Entomologica Americana, Lancaster, Pa.
e Entomological News, Philadelphia, Pa.
Evolution, Chicago, Ill.
* Explorations and Field Work of the Smithsonian Institution, Washington, D.C.
e Farm and Home Research, Wooster, Ohio.
e Farmers' Bulletin. United States Department of Agriculture, Washington, D.C. (ent.)
Fauna, Philadelphia, Pa.
o Federation Proceedings, Baltimore, Md.
Field and Laboratory. Contributions from the Science Departments of Southern Methodist University, Dallas, Tex.
Fieldiana. Zoology. Chicago, Ill.
e Florida Entomologist, Gainesville, Fla.
Frontiers, Philadelphia, Pa.
Genetics, Menasha, Wis.
Geographical Review, New York, N.Y.
Great Basin Naturalist, Provo, Utah.
Allan Hancock Foundation Publications, Los Angeles, Calif.
e Hilgardia. A Journal of Agricultural Science, Berkeley, Calif. (ent.)
Hobbies, Buffalo, N.Y.
e Illinois Biological Monographs, Urbana, Ill.
Indiana University Publications, Science Series, Bloomington, Ind.
Iowa State College Journal of Science, Ames, Iowa.
e Journal of Agricultural Research, Washington, D.C.
Journal of the Alabama Academy of Science, Birmingham, Ala.
o Journal of the American Medical Association, Chicago, Ill.
o Journal of the American Society of Agronomy, Geneva, N.Y.
e Journal of the American Veterinary Medical Association, Chicago, Ill.
o Journal of Biological Chemistry, Baltimore, Md.
= Journal of Cellular and Comparative Physiology, Philadelphia, Pa.
* Journal of the Cincinnati Society of Natural History, Cincinnati, Ohio.
e Journal of Economic Entomology, Menasha, Wis.
Journal of the Elisha Mitchell Scientific Society, Chapel Hill, N.C.
e Journal of Entomology and Zoology, Pomona College, Claremont, Calif.
o Journal of Experimental Medicine, Baltimore, Md.
Journal of Experimental Zoology, Philadelphia, Pa.
e Journal of Forestry, Washington, D.C.
o Journal of General Physiology, Baltimore, Md.
o Journal of Heredity, Baltimore, Md.
e Journal of the Kansas Entomological Society, Manhattan, Kans.
Journal of Mammalogy, Baltimore, Md.
Journal of Morphology (and Physiology), Philadelphia, Pa.
e Journal of the National Malaria Society, Tallahassee, Fla.
Journal of the New York Entomological Society, Lancaster, Pa.
e Journal of Parasitology, Lancaster, Pa.
Journal of the Scientific Laboratories of Denison University, Granville, Ohio.
Journal of the Tennessee Academy of Science, Nashville, Tenn.
Journal of the Washington Academy of Sciences, Menasha, Wis.
e Kansas University Science Bulletin, Lawrence, Kans.
e Leaflet. Alabama Agricultural Experiment Station, Auburn, Ala. (ent.)
* Leaflet. Mengel Natural History Society, Reading, Pa.
e Leaflet. United States Department of Agriculture, Washington, D.C. (ent.)
Lloydia, Menasha, Wis.
Madroño, Lancaster, Pa.
Masterkey (Southwest Museum), Los Angeles, Calif.
Memoirs of the American Academy of Arts and Sciences, Boston, Mass.
Memoirs of the American Entomological Society, Philadelphia, Pa.

United States of America (*contd.*)

Memoirs of the Boston Society of Natural History, Boston, Mass.

e Memoirs. Cornell University Agricultural Experiment Station, Ithaca, N.Y. (ent.)

Memoirs of the Museum of Comparative Zoology of Harvard College, Cambridge, Mass.

Memoirs of the Southern California Academy of Sciences, Los Angeles, Calif.

Memoirs of the University of California, Berkeley, Calif.

e Microentomology, Stanford University, Calif.

e Miscellaneous Publications. Maine Agricultural Experiment Station, Orono, Me. (ent.)

e Miscellaneous Publications of the Museum of Zoology, Univ. of Michigan, Ann Arbor. (ent.)

e Miscellaneous Publications. United States Department of Agriculture, Washington, D.C. (ent.)

Monographs of the Academy of Natural Sciences of Philadelphia, Philadelphia, Pa.

e Mosquito News, New Brunswick, N.J.

Museum Leaflet. Santa Barbara Museum of Natural History, Santa Barbara, Calif.

National Geographic Magazine, Washington, D.C.

e National Institute of Health Bulletin, United States Public Health Service, Washington, D.C. (ent.)

Natural History. Amer. Museum of Nat. History, New York, N.Y.

Natural History Miscellanea, Chicago, Ill.

o Naval Medical Bulletin, Washington, D.C.

New York Microscopical Society Bulletin, New York, N.Y.

Northwest Science, Cheney, Wash.

Notulae naturae, Philadelphia, Pa.

* Occasional Papers of the California Academy of Sciences, San Francisco, Calif.

Occasional Papers. Museum of Zoology, Louisiana State University, Baton Rouge, La.

e Occasional Papers of the Museum of Zoology, University of Michigan, Ann Arbor, Mich.

Occasional Papers of the San Diego Society of Natural History, San Diego County, Calif.

* Occasional Papers. Santa Barbara Museum of Natural History, Santa Barbara, Calif.

Occasional Papers. University of Minnesota Zoological Museum, Minneapolis, Minn.

e Ohio Journal of Science, Columbus, Ohio.

e Pan-Pacific Entomologist, San Francisco, Calif.

e Papers of the Michigan Academy of Science, Arts and Letters (Part II. Zoology), Ann Arbor, Mich.

Papers from the Tortugas Laboratory (Department of Marine Biology) of the Carnegie Institution of Washington, Washington, D.C.

e Pests and their Control, Kansas City, Mo.

e Physiological Zoölogy, Chicago, Ill.

Phytopathology. American Phytopathological Society, Lancaster, Pa.

e Picture Sheet. Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington, D.C.

Plateau, Flagstaff, Ariz.

e Popular Bulletin. Washington State Agricultural Experiment Station, Pullman, Wash. (ent.)

e Press Bulletin. Florida Agricultural Experiment Station, Gainesville, Fla. (ent.)

Proceedings of the Academy of Natural Sciences of Philadelphia, Philadelphia, Pa.

Proceedings of the American Academy of Arts and Sciences, Boston, Mass.

* Proceedings of the American Association for the Advancement of Science, Philadelphia, Pa.

* Proceedings of the American Philosophical Society, Philadelphia, Pa.

* Proceedings of the Biological Society of Washington, Washington, D.C.

Proceedings of the California Academy of Sciences, San Francisco, Calif.

e Proceedings of the Entomological Society of Washington, Washington, D.C.

Proceedings of the Helminthological Society of Washington, Washington, D.C.

Proceedings of the Indiana Academy of Science, Indianopolis, Ind.

Proceedings of the Iowa Academy of Science, Des Moines, Iowa.

Proceedings of the Linnaean Society of New York, New York, N.Y.

Proceedings of the Louisiana Academy of Sciences, Baton Rouge, La.

Proceedings of the Missouri Academy of Science, Columbia, Mo.

Proceedings of the National Academy of Sciences, Washington, D.C.

United States of America (*contd.*)

e Proceedings of the National Shade Tree Conferences, Columbus, Ohio.
e Proceedings. New Jersey Mosquito Extermination Association, New Brunswick, N.J.
e Proceedings of the New York State Horticultural Society, Rochester, N.Y.
e Proceedings. Ohio State Horticultural Society, Columbus, Ohio.
Proceedings of the Pennsylvania Academy of Science, Harrisburg, Pa.
Proceedings of the Portland Society of Natural History, Portland, Me.
Proceedings of the Rochester Academy of Science, Rochester, N.Y.
Proceedings of the Society for Experimental Biology and Medicine, New York, N.Y.
Proceedings of the South Dakota Academy of Science, Vermillion, S. Dak.
Proceedings and Transactions of the Texas Academy of Science, Houston, Tex.
e Proceedings of the United States National Museum, Washington, D.C. (ent.)
* Proceedings of the Utah Academy of Sciences, Salt Lake City, Utah.
e Psyche, a Journal of Entomology, Cambridge, Mass.
e Public Health Bulletin, Washington, D.C. (ent.)
e Public Health Reports, Washington, D.C.
e Publications. American Association for the Advancement of Science, Washington, D.C. (ent.)
* Publications of the American Association of Museums, Washington, D.C.
* Publications. Carnegie Institution of Washington, Washington, D.C.
Publications of the Carnegie Museum, Pittsburgh, Pa.
e Publications. Colorado Agricultural Experiment Station, Fort Collins, Colo.
Publications. University of Wyoming, Laramie, Wyo.
* Publications of the Wagner Free Institute of Science, Philadelphia, Pa.
e Quarterly Bulletin. Michigan Agricultural Experiment Station, East Lansing, Mich.
Quarterly Journal of the Florida Academy of Sciences, Tallahassee, Fla.
Quarterly Review of Biology, Baltimore, Md.
e Report of the Alabama Agricultural Experiment Station, Auburn, Ala.
Report of the American Museum of Natural History, New York, N.Y.
e Report. Arizona Agricultural Experiment Station, Tucson, Ariz.
e*Report. California Agricultural Experiment Station, Berkeley, Calif.
e Report of the Chief of the Bureau of Animal Industry, Agricultural Research Administration, United States Department of Agriculture, Washington, D.C.
e Report of the Chief of the Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, United States Department of Agriculture, Washington, D.C.
e Report. Colorado Agricultural Experiment Station, Fort Collins, Colo.
e Report. Cornell University Agricultural Experiment Station, Ithaca, N.Y.
e Report. Department of Agriculture and Conservation, Rhode Island, Providence, R.I.
e Report. Florida Agricultural Experiment Station, Gainesville, Fla.
e*Report of the Illinois Agricultural Experiment Station, Urbana, Ill.
e Report. International Health Division, Rockefeller Foundation, New York, N.Y.
* Report of the Laboratory and Museum of Comparative Pathology of the Zoological Society of Philadelphia, Philadelphia, Pa.
Report of the Museum of Comparative Zoology at Harvard University, Cambridge, Mass.
e Report of the New Mexico Agricultural Experiment Station, State College, N. Mex.
e Report of the New York State Agricultural Experiment Station, Geneva, N.Y.
Report of the New York Zoological Society, New York, N.Y.
e Report. Oklahoma Agricultural Experiment Station, Stillwater, Okla.
e Report of the South Carolina Agricultural Experiment Station, Clemson, S.C.
e Report. Texas Agricultural Experiment Station, College Station, Tex.
Report of the United States National Museum, Smithsonian Institution, Washington, D.C.

United States of America *(contd.)*

e Research Bulletin. Iowa Agricultural Experiment Station, Ames, Iowa. (ent.)
e Research Bulletin. Missouri Agricultural Experiment Station, Columbia, Mo. (ent.)
e Research Bulletin. Nebraska Agricultural Experiment Station, Lincoln, Neb. (ent.)
e Research Bulletin. Wisconsin Agricultural Experiment Station, Madison, Wis. (ent.)
Research Studies. State College of Washington, Pullman, Wash.
e Review. Rockefeller Foundation, New York, N.Y.
e Review of U.S. Patents relating to Pest Control, Washington, D.C.
Rhodora. Journal of the New England Botanical Club, Boston, Mass.
Science, Lancaster, Pa.
Science Bulletin. Museum of the Brooklyn Institute of Arts and Sciences, New York, N.Y.
Science Bulletin. Ohio State Museum, Columbus, Ohio.
Scientific Publications. Cleveland Museum of Natural History, Cleveland, Ohio.
e Scientific Publications of the Reading Public Museum and Art Gallery, Reading, Pa.
Scientific Survey of Porto Rico and Virgin Islands, New York, N.Y.
e Service and Regulatory Announcements. Bureau of Entomology and Plant Quarantine, United States Department of Agriculture, Washington, D.C.
e Smithsonian Miscellaneous Collections, Washington, D.C. (ent.)
e Soap and sanitary Chemicals, New York, N.Y.
o Southern Medical Journal, Birmingham, Ala.
e Special Bulletin. Michigan Agricultural Experiment Station, East Lansing, Mich. (ent.)
* Stanford University Publications. University Series. Biological Sciences. Palo Alto, Calif.
Studies in Natural History, Iowa University, Iowa City, Iowa.
e Technical Bulletin. Arizona Agricultural Experiment Station, Tucson, Ariz. (ent.)
e Technical Bulletin. Colorado Agricultural Experiment Station, Fort Collins, Colo. (ent.)
e Technical Bulletin. Kansas Agricultural Experiment Station, Manhattan, Kans. (ent.)
e Technical Bulletin. Michigan Agricultural Experiment Station, East Lansing, Mich. (ent.)
e Technical Bulletin. Minnesota Agricultural Experiment Station, St. Paul, Minn. (ent.)
e Technical Bulletin. Mississippi Agricultural Experiment Station, Agricultural College, Miss. (ent.)
e Technical Bulletin. New Hampshire Agricultural Experiment Station, Durham, N.H. (ent.)
e Technical Bulletin. New York State Agricultural Experiment Station, Geneva, N.Y. (ent.)
e Technical Bulletin. Oklahoma Agricultural Experiment Station, Stillwater, Okla. (ent.)
e Technical Bulletin. South Dakota Agricultural Experiment Station, Brookings, S. Dak. (ent.)
e Technical Bulletin. United States Department of Agriculture, Washington, D.C. (ent.)
e Technical Bulletin. Virginia Agricultural Experimental Station, Blacksburg, Va. (ent.)
o Texas Reports on Biology and Medicine, Galveston, Tex.
Transactions of the Academy of Science of St. Louis, St. Louis, Mo.
e Transactions of the American Entomological Society, Philadelphia, Pa.
Transactions of the American Microscopical Society, Menasha, Wis.
Transactions of the American Philosophical Society, Philadelphia, Pa.
Transactions of the Connecticut Academy of Arts and Sciences, New Haven, Conn.
Transactions of the Illinois State Academy of Science, Springfield, Ill.
e Transactions of the Illinois State Horticultural Society, Quincy, Ill.
Transactions of the Kansas Academy of Science, Manhattan, Kans.
e Transactions of the Peninsula Horticultural Society, Dover, Del.
Transactions of the San Diego Society of Natural History, San Diego, Calif.
Transactions of the Wisconsin Academy of Sciences, Arts and Letters, Madison, Wis.
o Tropical Medicine News, New Orleans, La.
University of Arizona Bulletin. Biological Series, Tucson, Ariz.
e University of California Publications in Entomology, Berkeley, Calif.
e University of California Publications in Zoology, Berkeley, Calif.

United States of America (*contd.*)

* University of Chicago Science Series, Chicago, Ill.

University of Colorado Studies, Boulder, Colo.

* University of Florida Publication. Biological Science Series. Gainesville, Fla.

University of Missouri Studies, Columbia, Mo.

University of Nebraska Studies, Lincoln, Neb.

University of Texas Publication, Austin, Tex.

University of Washington Publications in Biology, Seattle, Wash.

* Virginia Journal of Science, Lexington, Va.

Wasmann Collector, San Francisco, Calif.

Yearbook. Carnegie Institution of Washington, Washington, D.C.

Zoologica. Scientific Contributions of the New York Zoological Society, New York, N.Y.

United States Territories and Island possessions.

Bulletin of the Bernice Pauahi Bishop Museum, Honolulu.

e Bulletin. Hawaii Agricultural Experiment Station, Honolulu. (ent.)

e Bulletin. Hawaiian Sugar Planters' Association. Experiment Station (Entomological Series), Honolulu.

e Bulletin. Porto Rico [Federal] Agricultural Experiment Station, Mayaguez, Washington, D.C. (ent.)

e Bulletin. Porto Rico Agricultural Experiment Station, University of Porto Rico, Río Piedras. (ent.)

e Caribbean Forester, Río Piedras.

e Circular. Hawaii Agricultural Experiment Station, Honolulu. (ent.)

e Circular. Porto Rico [Federal] Agricultural Experiment Station, Mayaguez. (ent.)

e Circular. Porto Rico Agricultural Experiment Station, University of Porto Rico, Río Piedras. (ent.)

o Hawaii Medical Journal, Honolulu.

e Hawaiian Planters' Record, Honolulu.

e Journal of Agriculture of the University of Puerto Rico, Río Piedras.

* Memoirs of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History, Honolulu.

Occasional Papers of the Bernice Pauahi Bishop Museum of Polynesian Ethnology and Natural History, Honolulu.

Proceedings. Hawaiian Academy of Science, Honolulu.

e Proceedings of the Hawaiian Entomological Society, Honolulu.

e Puerto Rico Journal of Public Health and Tropical Medicine, Brattleboro', Vt.

e Report. Agricultural Experiment Station, University of Porto Rico, Río Piedras.

e Report of the Experiment Station Committee, Hawaiian Sugar Planters' Association, Honolulu.

e Report of the Hawaii Agricultural Experiment Station, Honolulu.

e Report of the Health Department of the Panama Canal, Balboa Heights, Canal Zone.

e Report. Porto Rico [Federal] Agricultural Experiment Station, Mayaguez, Washington, D.C.

e Research Bulletin. Agricultural Experiment Station, University of Porto Rico, Río Piedras.

Special Publications. Bernice Pauahi Bishop Museum, Honolulu.

e Technical Bulletin. Hawaii Agricultural Experiment Station, Honolulu. (ent.)

e Technical Papers. Agricultural Experiment Station, University of Porto Rico, Río Piedras. (ent.)

Uruguay.

* Anales del Museo de historia natural de Montevideo, Montevideo.

Archivos de la Sociedad de biología de Montevideo, Montevideo.

Boletín de la Sociedad amigos de las ciencias naturales "Kraglievich-Fontana", Nueva Palmira.

Venezuela.

e Boletín de entomologia venezolana, Caracas.

Boletín del Laboratorio de la clínica "Luis Razetti", Caracas.

e Boletín de la Sociedad venezolana de ciencias naturales, Caracas.

Memorias de la Sociedad de ciencias naturales La Salle, Caracas.

e Revista de medicina veterinaria y parasitología, Caracas.

Venezuela (*contd*).

e Revista de sanidad y asistencia social, Caracas.

e Tijeretazos sobre malaria, Maracay.

Yugoslavia.

* Acta Societatis entomologicae Jugoslavicae, Belgrade.

e Arhiv za Poljoprivredne Nauke i Tehniku, Belgrade.

* Bulletin de la Société scientifique de Skoplje, Uskub.

* Glas srpske Kralevske Akademije, Belgrade.

* Glasnik Hrvatskoga prirodoslovnoga Društva, Zagreb.

e*Glasnik Zentralnog Khigijenskog Zavoda, Belgrade.

* Prirodoslovna Istraživanja Kraljevine Jugoslavije, Zagreb.

* Prirodoslovne Razprave, Ljubljana.

INTERNATIONAL.

e Bulletin of the World Health Organization, Geneva and New York.

e Chronicle of the World Health Organization, Geneva and New York.

e Food and Agriculture. The FAO European Bulletin, Rome.

e Revista do Serviço especial de saúde pública, Rio de Janeiro.

e*Transactions of the Far-Eastern Association of Tropical Medicine.

e International Congress of Entomology. Proceedings.

International Congress of Zoology. Reports.

e International Locust Conference. Proceedings.

e Pacific Science Congress. Proceedings.

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ERRATA.

Page 41 line 24 for "mites" read "lice"
,, 73 line 2 for "**32** 152" read "**33** 152"
,, 78 10 lines from end for "different" read "difficult"
,, 82 3 lines from end for "bug" read "dog"
,, 121 18 lines from end for "*Culiseta*" read "*Mansonia*"
,, 138 line 23 for "zooprophilism" read "zoophilism"